EBnet

Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Tropical Rainfall Measurement Mission (TRMM) Review

November 8, 1995

Steven A. Smith
EBnet Project Manager

EBnet

I. A. Introduction

Hal Folts

Agenda

I.	Introduction	8:00 - 8:20
II.	Requirements	8:20 - 9:00
	A. Requirements Overview	
	B. Traffic Requirements and Modeling	
	C. Interface Requirements	
	D. Adaptive Downlink Architecture	
III.	EBnet Design	9:00 - 10:00
	A. EBnet Topologies	
	B. Network Routing/Addressing	
	C. Site Designs	
	D. Site Visits	
	B R E A K	10:00 - 10:15
	E. Testing	10:15 - 11:00
	F. Network Management System Design for TRMM	
	G. Network Management System Design for AM-1	
IV.	Operations Concepts	11:00 -11:25
	A. Operations Concept for TRMM	
	B. Operations Concept for AM-1	
V.	Risks	11:25 - 11:50
VI.	Conclusion	11:50 - 12:00

EBnet TRMM Review

- Purpose
  - Provide details of the EBnet architecture and planned capabilities, along with the status and schedule of work in progress
  - Place supporting system design phase documentation under configuration control
- Scope
  - EBnet readiness to support TRMM
  - Preliminary EBnet design for AM-1

Success Criteria

- Establish functional and performance requirements, and traffic requirements baseline for TRMM and AM-1
- Specify all external and internal interfaces for TRMM, and preliminarily identified those for AM-1
- Define set of required documents
- Define TRMM operations concept
- Demonstrate schedule for TRMM and AM-1 is adequate for testing end-to-end capabilities
- Complete TRMM network transport and management capabilities, design, and circuit topology; preliminary AM-1 design and circuit topology identified
- Consider all significant implementation events, critical path, external dependencies, and risk mitigation plans in place

EBnet Documentation Summary

Status Briefing

- ESDIS Requirements Document, Volume 6, for the EBnet Project (Draft)
- Interface Requirements Document (Draft)

External Test Readiness Review

- Test Report

TRMM Review

- ESDIS Requirements Document, Volume 6, for the EBnet Project (Final)
- Interface Requirements Document (Final)
- Review Package
- Interface Control Documents (Draft)

Operational Readiness Review

- Station Handbook
- As-Built Documents and Design Description

AM-1 Design Review

- Design Package
- System Test Plan
- System Implementation Plan
- Interface Control Documents
- Operations Concept Document

Documents not specific to a review

- Site Installation Checkout Plans and Procedures
- EBnet Modeling, Analysis, and Testbed (EMAT) Reports
- Training Course Materials and Evaluations

Documentation Associated With This Review

- The review will present information contained in the following documents:
  - ESDIS Requirements Document, Volume 6, for the EBnet Project [Final, configuration control by the Code 505 Configuration Control Board]
  - Interface Requirements Document [Final, configuration control by the Code 540 Configuration Control Board]
  - Interface Control Documents (ICDs) [Draft]
  - EBnet TRMM Review Presentation Material
- Documents and presentation material can be accessed from the EBnet Home Page at:
  - http://skynet.gsfc.nasa.gov/EBNET/EBnet.html
- Documents and presentation material subject to Review Item Disposition (RID) process

RID Process

- Use the RID form as supplied in hard-copy or on-line at the EBnet Home Page
- Transmit RIDs via electronic mail to BERGANSKIK@BAH.COM by 11/20/95
- Members of the EBnet staff will work with RID submitters

[Note that “COMMENT/CLARIFICATION FORMS” are located in the back of the auditorium; complete the form to submit a comment or to have one of our presenters contact you to elaborate on a point made during the presentation.]

I. B. Introduction

Steve Smith

Introduction

- EBnet requirements for TRMM and AM-1 provided through multiple sources
- EBnet requirements allocated to specific Internet Protocol (IP) network or legacy system by Nascom
- NASA Communications (Nascom) evolving toward one physical IP network which will carry all IP traffic
  - EBnet is viewed as a “logical” network of EOSDIS Internal Network Requirements

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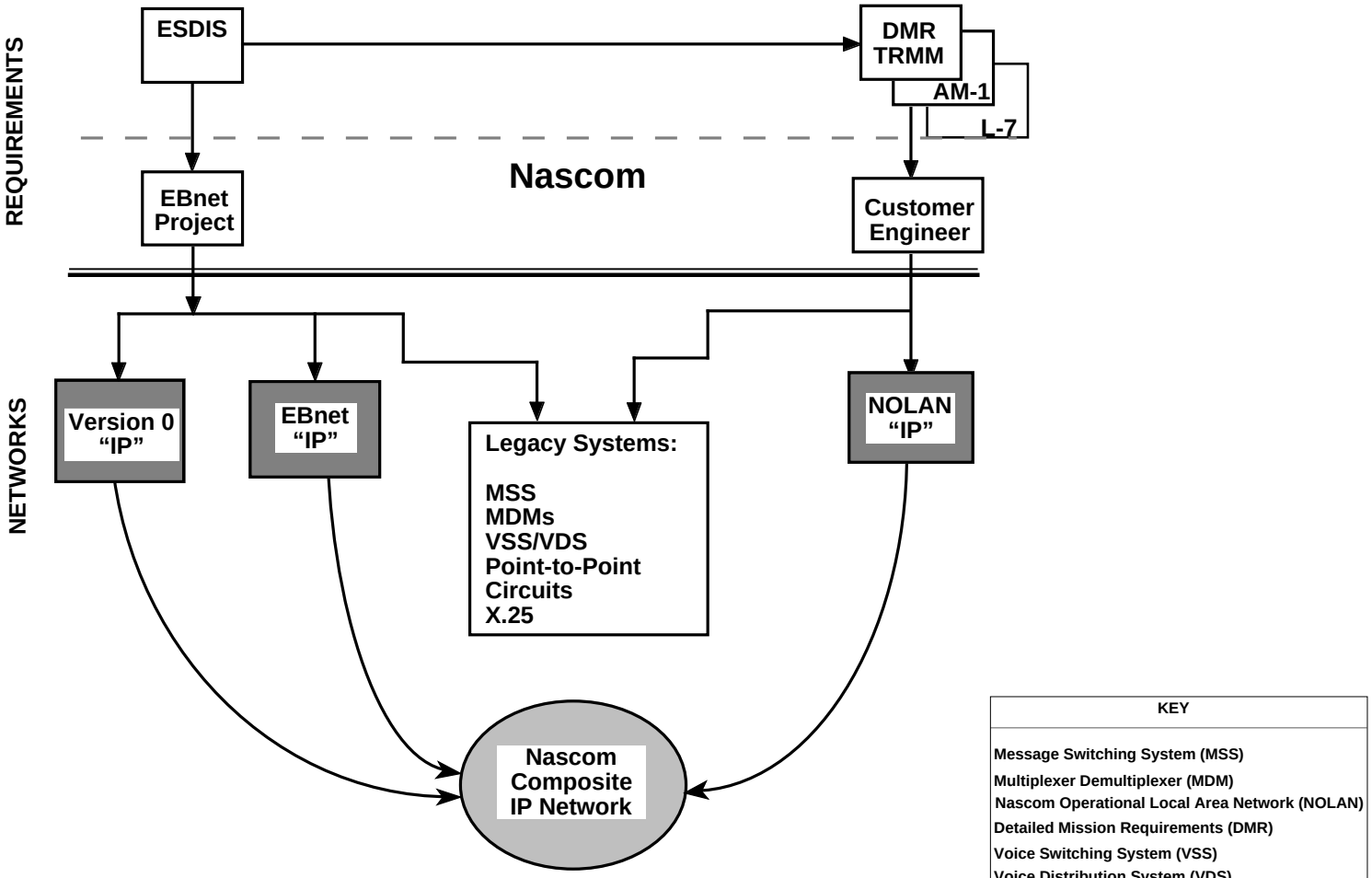
EOSDIS Internal Network Requirements Allocation



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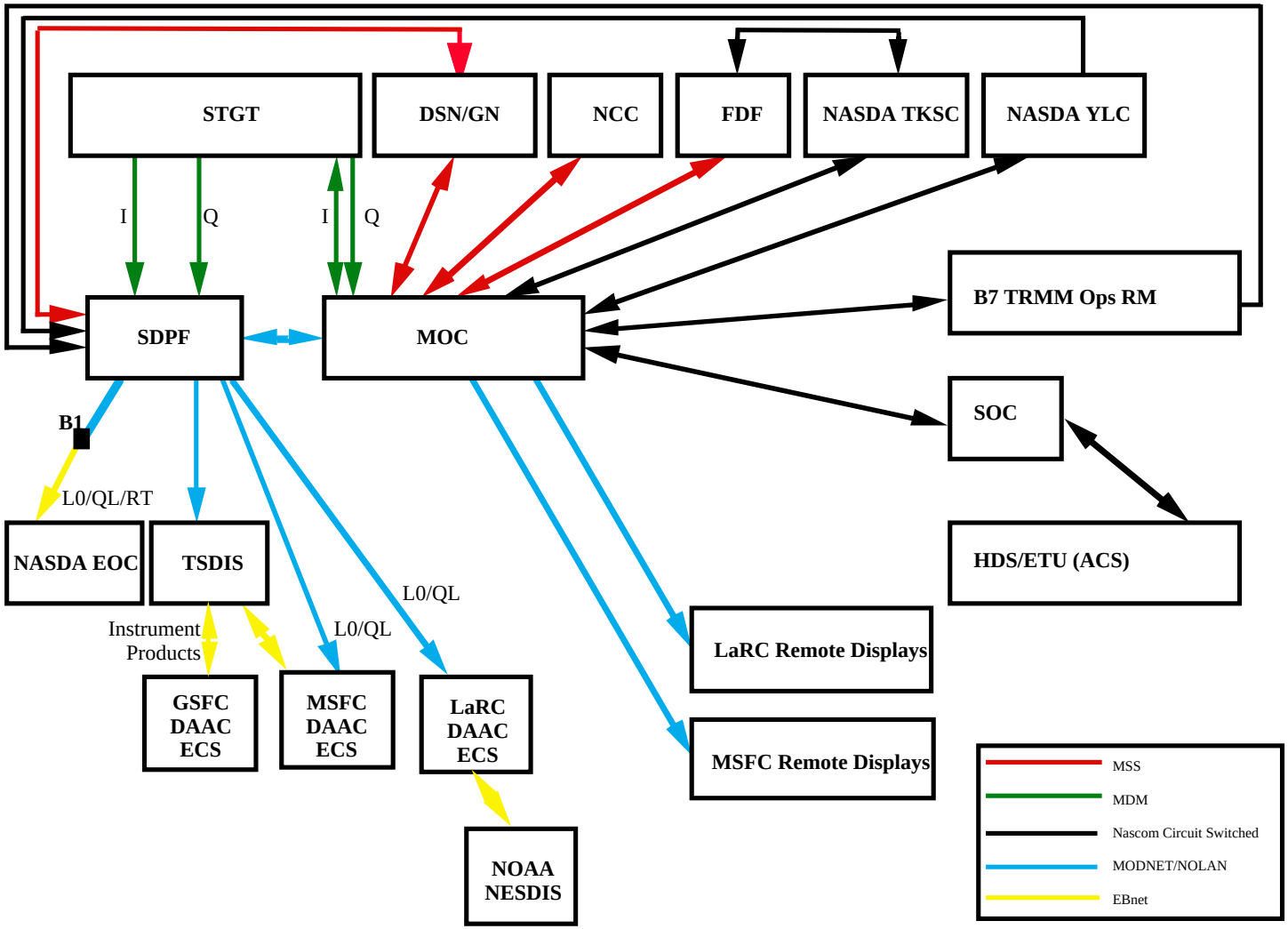
Requirements Allocation for TRMM



Introduction

- External milestones identified as EBnet schedule drivers:
  - TRMM test support required by January 1996 (IR-1)
  - TRMM test support required by July 1996 (Release A)
  - AM-1 test support required by January 1997 (Release B)
- EBnet readiness to support TRMM
  - TRMM IR-1 testing being supported by Version 0 network with minimal capacity upgrades required
    - EBnet being accomplished by integration of existing commercial routers and commercial circuits
  - TRMM Release A design will be presented in detail

Introduction (cont'd)

- Preliminary AM-1 design presentation will focus on current status of interface definition, data flows, planned topology, and integration and test plans
  - Final EBnet design dependent on completion of ECS Release B information and documentation of user end system; ECS Release B information will be available to accommodate EBnet AM-1 Review in April 1996
  - Circuit/equipment acquisition and implementation of network build-out to full EBnet capability will accommodate "just in time" upgrades and bandwidth enhancements

II. A. Requirements Overview

Paul Sullivan

Requirements Overview

- EBnet Requirements
- Requirements Categories
- System Requirement Drivers
- Other Key Requirements
- Requirement Issues

EBnet Requirements

- EBnet requirements consists of consolidated EOS Communications (Ecom) and ECS Science Network (ESN) requirements set with tailoring to meet RESHAPE effort
- EBnet requirements documented in the ESDIS Level 2 Requirements, Volume 6, EBnet Requirements (505-10-01-6). This document:
  - Replaces the Ecom part of the Volume 2, EDOS and Ecom Requirements
  - Uses Execution Phase Project Plan for EOS, Revision A and ESDIS Level 2, Volume 0, Overall ESDIS Project Requirements as sources
  - Table 4, Volume 0 and Data Item Description (DID) 223 referenced
  - Defines functional objectives of EBnet: (1) EOS ground transport means; and (2) supply network management to support EBnet operations
- EBnet Requirements Document will support the activities of both ESDIS and EBnet projects. EBnet project will use the EBnet Requirements Document to develop design and verify requirements

Requirement Categories

- Programmatic
- Overall System
  - General
  - Integration and Test
  - Prelaunch, Early Orbit and Disposal Support
  - Reliability, Maintainability, Availability (RMA)
  - System Access
  - Security
  - End-to-End Fault Management
- EBnet Functions
  - Mission Operations
  - Data Distribution
  - Communications and Networking
  - Network Management
- Interfaces

System Requirement Drivers

- EBnet shall include development, testing, operations and maintenance for life of supported missions in Table 8-1 of Execution Phase Project Plan (TRMM, Landsat-7, EOS-AM, ADEOS II, RADAR ALT, ACRIM, EOS-PM, SAGE, CHEM, Laser ALT, and SOLSTICE); EOS and LANDSAT supported for additional 3 years
- EBnet shall support operations 24 hours per day, 7 days per week on a continuous basis
- EBnet shall be designed to accommodate growth in data rates and volume as specified in Table 4 and DID223 (ECS Project)
- EBnet will maintain a Bit Error Rate of 1x10-4 for packet size of $\leq$1,000 bits and 1x10-3 for packet size of $\leq$ 10,000 bits (To Be Reviewed [TBR])
- EBnet shall transport data within maximum one-way delay of 0.5 second
- EBnet transport services shall be transparent to users

Other Key Requirements

- RMA requirements for real-time, science data communications and network management:
  - Real-time is .9998 availability and 1 minute Mean Time To Restore Service (MTTRS)
  - Science is .98 availability and 4 hours MTTRS
  - Network management is .96 availability and 4 hours MTTRS
- EBnet shall provide connectivity and data transport as specified in the EBnet Traffic Database
- EBnet shall support all EOS spacecraft mission phases and modes
- EBnet/Nascom shall provide the capability to support contingency mode operations with Deep Space Network (DSN) and Ground Network (GN) including Wallops Orbital Tracking Station (WOTS)
- EBnet shall be able to duplicate network management functionality within 24 hours of catastrophic loss of network management system

Requirement Issues

- EBnet will maintain a Bit Error Rate of 1x10-4 for packet size of ≤1,000 bits (TBR Number 1) and 1x10-3 for packet size of ≤ 10,000 bits (TBR Number 2)
  - Recommended Work-off Plan involves design analysis by EBnet Modeling Analysis Testbedding (EMAT)
- EBnet, in combination with EDOS, shall have contribution to the overall real-time operations (command up acknowledge back) loop delay of no more than 2.5 seconds (TBR Number 3)
  - Recommended Work-off Plan involves issue review/resolution at the ESDIS Requirements Issues Working Group
- Support of Level 1 48 hour backlog requirement
  - Recommended Work-off Plan involves issue review/resolution at the ESDIS Requirements Issues Working Group

II. B. Traffic Requirements and Modeling

Ryan Collins

Overview

- Methodology
- Inputs
- Analysis
- Traffic Model
- Outputs

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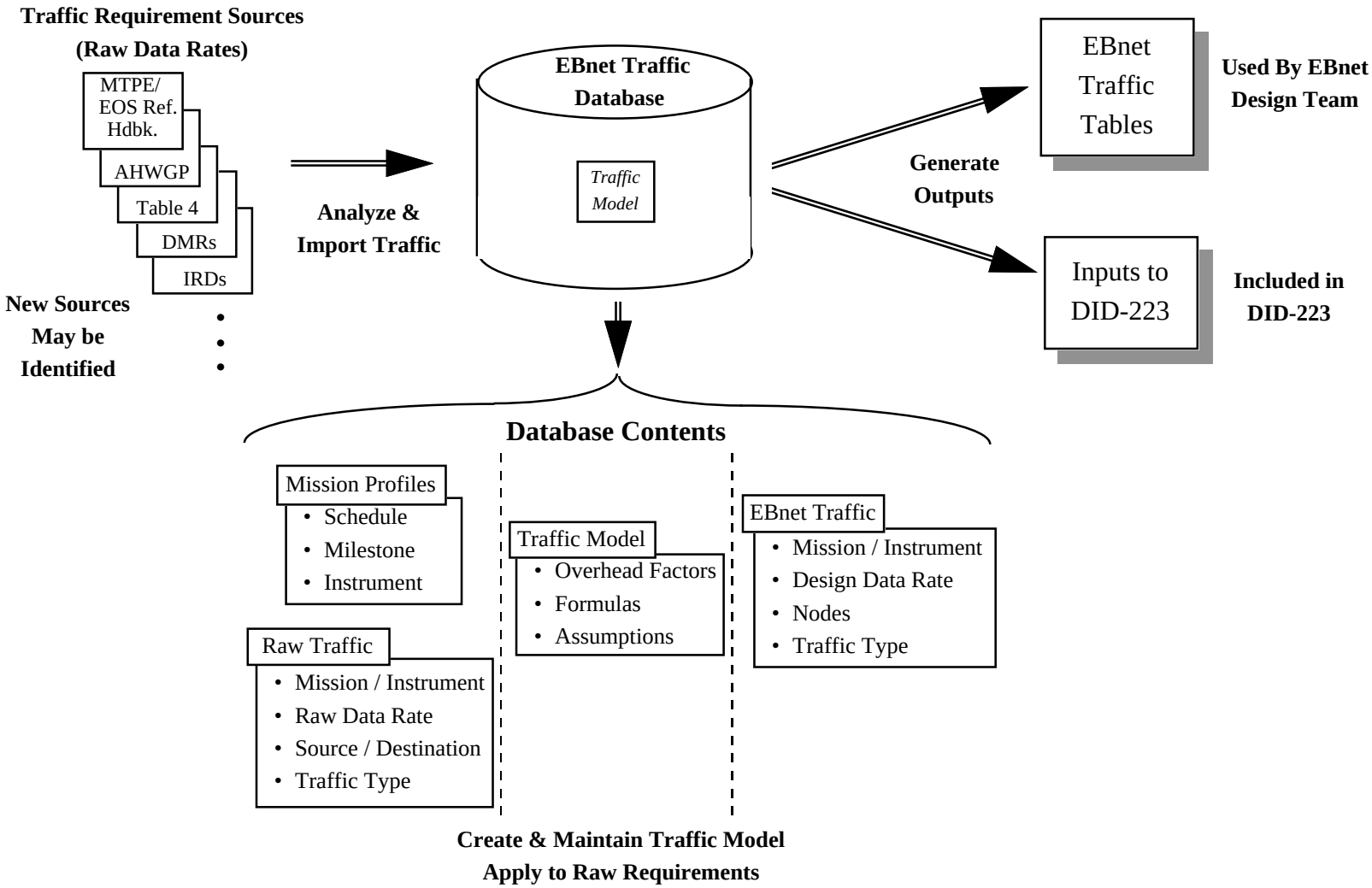
Methodology



Inputs

- Requirements Sources
  - ESDIS Level 2 Requirements Document, Table 4
    - EDOS flows (between ECS and other elements)
  - Ad Hoc Working Group on Production (AHWGP)
    - Inter-DAAC science product traffic
    - Inter-DAAC user query / query response and ancillary data set traffic
  - EOSDIS Interface Requirement Documents (IRD): TRMM & Landsat-7
  - Detailed Mission Requirements (DMR) Documents: TRMM & Landsat-7
  - New sources are being identified and will be incorporated (e.g., ECS ICDs)
- Mission Profiles
  - Mission to Planet Earth (MTPE) / EOS Reference Handbook
  - Mission Requirements and Data Systems Support Forecast (501-803)
- When fully populated and mature, the EBnet Traffic Database will be controlled by established Code 540 procedures

Analysis

- Objective: Obtain node-to-node data volumes based on raw requirements and need dates
- Step One: Requirements Analysis
  - Identify timeframe when requirements must be satisfied
  - Identify mutually exclusive requirements
  - Determine whether to design on raw average or raw peak data rate
  - Determine the protocol to be used for requirements
- Step Two: Application of the Traffic Model
  - Burden raw data rates with overhead factors to obtain design data rates
- Step Three: Support “What If” and Tradeoff Analyses
  - Adaptive Downlink Architecture
  - Use of Subsetting

Traffic Model

- Objective: Burden raw data rates with overhead factors to obtain design data rates
  - Circuit Utilization Factor (e.g., 1.25 to accommodate queuing theory limit)
  - Protocol Overheads
  - Retransmission Overhead
  - Contingency / Peaking Factors
  - Time Factors (e.g., 50/35 to transport 50 minutes of data in 35 minutes)
- Method
  - Derive modeling factors
    - Meetings with interfacing elements (e.g., EDOS, ECS, etc.)
    - Best engineering design practices
  - Apply factors to traffic requirements
  - Calculate design data rates
- Result: [Design Rate] = [Raw Rate] * [Overhead Factors]

Database Output

- EBnet Traffic Tables
  - Used to design network topology
  - Summary of design data rates grouped by source and destination
  - Real-time and science traffic
  - Time phased
- Input to DID-223
  - Summary of traffic into, out of, or within ECS by year
- Materials for Quarterly Review by ESDIS / DSNO
  - To be defined

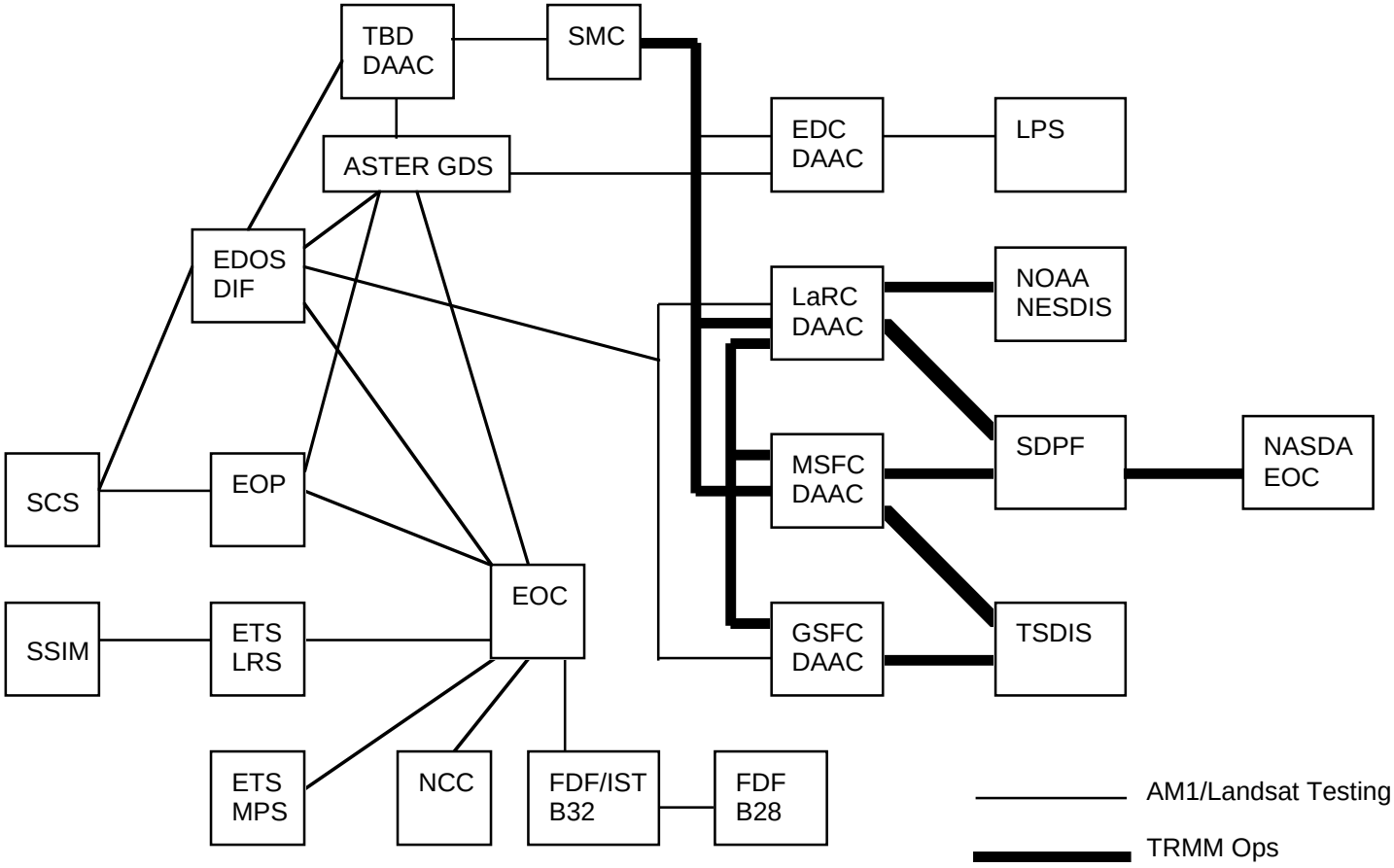
II. C. Interface Requirements

Chris Garman

Overview

- EBnet Interfaces for Release A
- EBnet Interfaces for Release B
- Interface Control Document (ICD) Need Dates

EBnet Interfaces for Release A Support

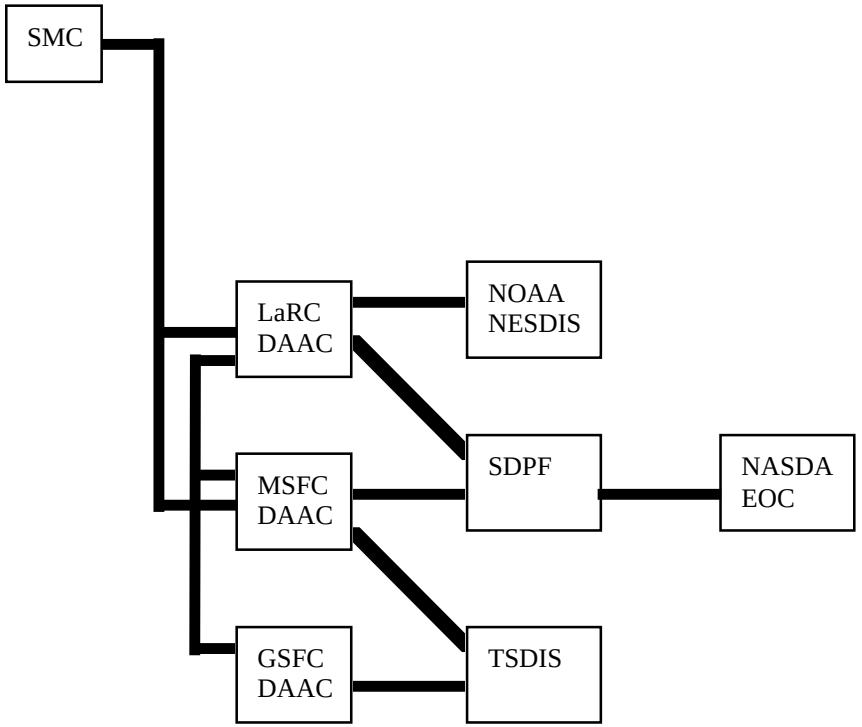


System Acronym List

ASTER GDS	Advanced Spaceborne Thermal Emission Radiometer Ground Data System
DAAC	Distributed Active Archive System
EDOS DIF	EOS Data and Operations System Data Interface Facility
EOC	EOS Operations Center
EOP	EDOS Operational Prototype
ETS LRS	EOS Test System Low Rate System
ETS MPS	EOS Test System Multimode Portable Simulator
FDF	Flight Dynamics Facility
FSTB	Flight Software Testbed
GSE	Ground Support Equipment
IST	Instrument Support Terminal
LPS	Landsat Processing System
NASDA EOC	National Space Development Agency (of Japan) Earth Observation Center
NCC	Network Control Center
NESDIS	National Environmental Satellite, Data and Information Service
SAS	Spacecraft Analysis Software
SCS	Spacecraft Checkout Station
SMC	System Monitoring and Coordination Center
SDF	Software Development Facility
SDPF	Science Data Processing Facility
SSIM	Spacecraft Simulator
TSDIS	TRMM Science Data and Information System

TRMM Data Ops

- DAAC - Distributed Active Archive System
- GSFC - Goddard Spaceflight Center
- LaRC - Langley Research Center
- MSFC - George C. Marshall Spaceflight Center
- NASDA EOC - National Space Development Agency (of Japan) Earth Observation Center
- NESDIS - National Environmental Satellite, Data and Information Service
- NOAA - National Oceanographic and Atmospheric Administration
- SMC - System Monitoring and Coordination Center
- SDPF - Science Data Processing Facility
- TSDIS - TRMM Science Data and Information System

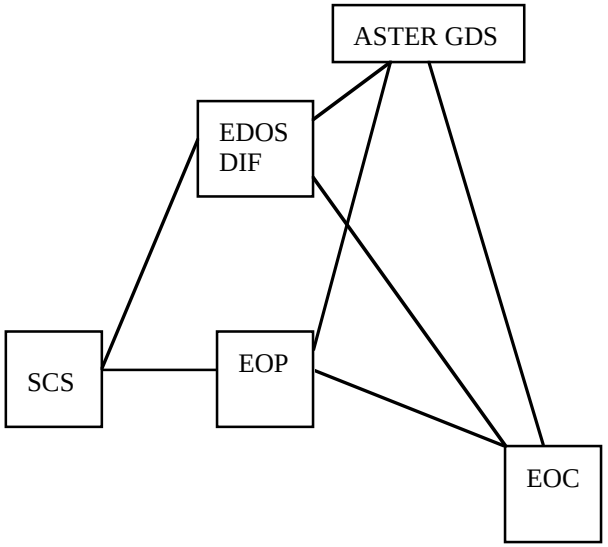


TRMM Data Ops Interface Description

System	Release A Location	Need dates*	Data rates
GSFC DAAC	Bldg 32	7/96	to TSDIS: 500 Kbps to MSFC DAAC: 10 Mbps to SMC: 512 Kbps
LaRC DAAC	LaRC	7/96	to SMC: 512 Kbps
MSFC DAAC	MSFC	7/96	to TSDIS: 1.5 Mbps to GSFC DAAC: 14 Mbps to LaRC DAAC: 1 Mbps to SMC: 512 Kbps
NASDA EOC	Japan	In Place	
NESDIS	Suitland MD	In Place	to LaRC DAAC: 50 Kbps
SDPF	Bldg 23	In Place	to LaRC DAAC: 25 Kbps to MSFC DAAC: 15 Kbps to NASDA EOC: 400 Kbps
SMC	Bldg 32	7/96	to DAACs: 64 Kbps per DAAC
TSDIS	Bldg 32	In Place	to GSFC DAAC: 1.9 Mbps to MSFC DAAC: 18 Mbps

*ECS need date for Release A

Realtime Ops (AM1 testing)



- ASTER GDS - Advanced Spaceborne Thermal Emission Radiometer Ground Data System
- EDOS DIF - EOS Data and Operations System Data Interface Facility
- EOC - EOS Operations Center
- EOP - EDOS Operational Prototype
- SCS - Spacecraft Checkout Station

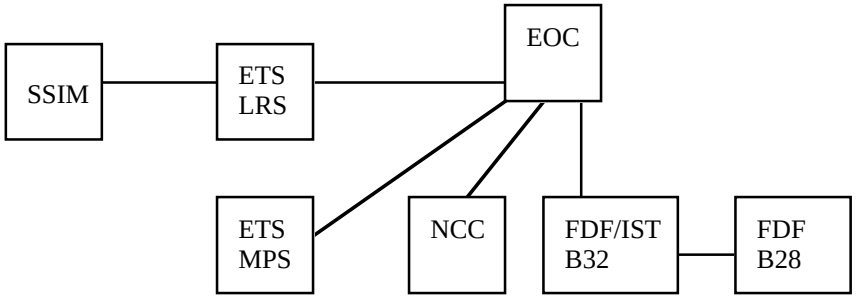
Realtime Ops Interface Description

System	Release A Location	Need dates	Data rates
ASTER GDS	Tokyo	TBD	to EOC: TBD
EDOS DIF	WSC and/or Bldg 32 (TBD)	5/97	to EOC: 42 Kbps RT to EOC: 1 Mbps other to SCS: 0.125, 1, 2, or 10 Kbps (c/d)
EOC	Bldg 32	8/96	to EDOS DIF: 17 Kbps RT to EDOS DIF: 1 Mbps other
EOP*	TRW/Bldg 32/WSC (TBD)	5/96 at TRW 10/96 at Bldg 32 1/97 at WSC	(same as EDOS DIF)
SCS	Valley Forge, PA	10/96 to 3/98	to EDOS DIF: 1, 16, or 256 Kbps (c/d) to EOP: (same as EDOS DIF)

*EOP and EDOS DIF are assumed to be mutually exclusive

EOC Support (AM1 testing)

- EOC - EOS Operations Center
- ETS LRS - EOS Test System Low Rate System
- ETS MPS - EOS Test System Multimode Portable Simulator
- FDF - Flight Dynamics Facility
- IST - Instrument Support Terminal
- NCC - Network Control Center
- SSIM - Spacecraft Simulator

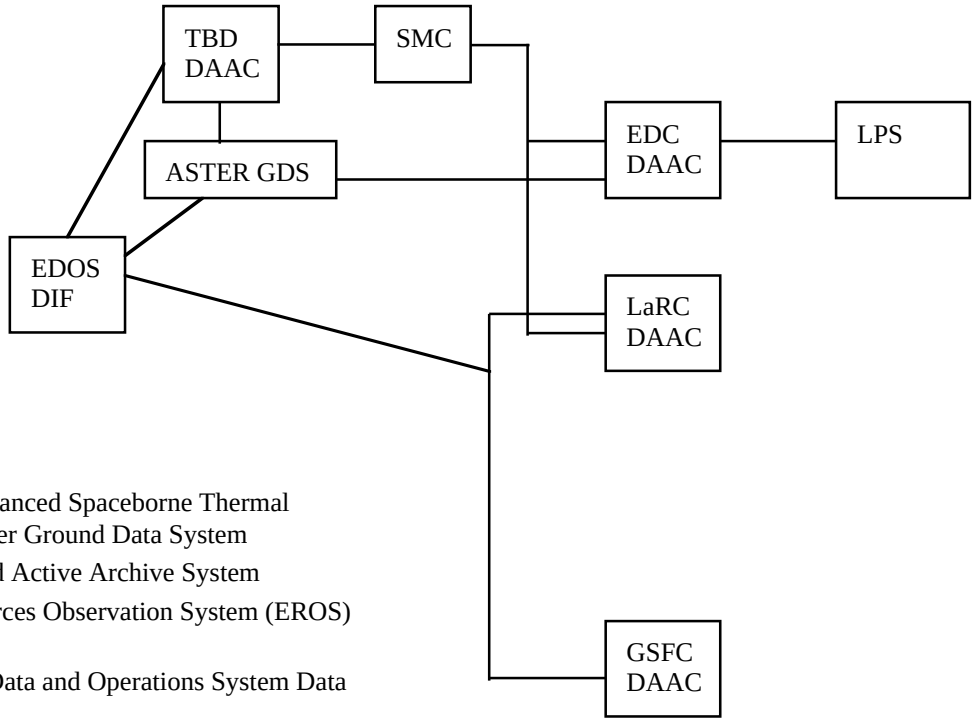


EOC Support Interface Description

System	Release A Location	Need dates	Data Rates
EOC	Bldg 32	8/96	to FDF: 512 Kbps to NCC: 56 Kbps to ETS LRS: (same as EDOS DIF) to ETS MPS: (same as EDOS DIF)
FDF	Bldg 32 and Bldg 28	TBD	to EOC: 512 Kbps to FDF: 512 Kbps
NCC	Bldg 13	TBD	to EOC: 224 Kbps
SSIM*	Valley Forge, PA	1/97 to 6/97	to ETS LRS: (same as EDOS DIF)
ETS LRS	Bldg 25 and/or Bldg 32 (TBD)	6/96	to EOC: (same as EDOS DIF) to SSIM: (same as EDOS DIF)
ETS MPS	Bldg 25 and/or Bldg 32 (TBD)	6/96	to EOC: (same as EDOS DIF)

*SSIM and SCS (Realtime Ops) are assumed to be mutually exclusive

Science data (AM1 and Landsat testing)



- ASTER GDS - Advanced Spaceborne Thermal Emission Radiometer Ground Data System
- DAAC - Distributed Active Archive System
- EDC - Earth Resources Observation System (EROS) Data Center
- EDOS DIF - EOS Data and Operations System Data Interface Facility
- LPS - Landsat Processing System
- SMC - System Monitoring and Coordination Center

Science Data Interface Description

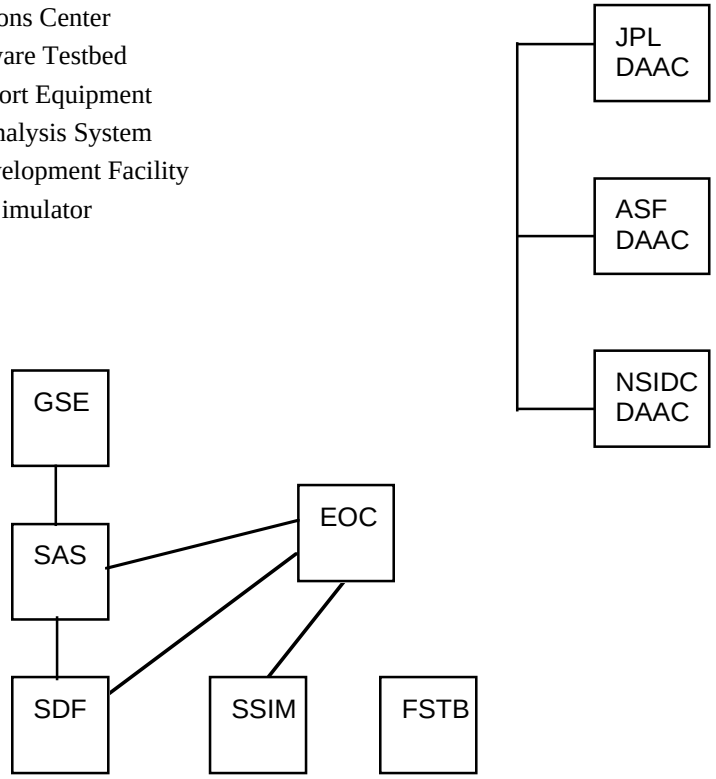
System	Release A Location	Need dates*	Data Rates**
ASTER GDS	Tokyo	TBD	to EDC DAAC: TBD to EDOS DIF: TBD
GSFC DAAC	Bldg 32	7/96	to LaRC DAAC: 20 Mbps to EDC DAAC: 8 Mbps to SMC: 512 Kbps
LaRC DAAC	LaRC	7/96	to EDC DAAC: 350 Kbps to SMC: 512 Kbps
EDC DAAC	EDC	7/96	to GSFC DAAC: 2 Mbps to SMC: 512 Kbps
TBD DAAC	TBD	7/96	to SMC: 512 Kbps
EDOS DIF	WSC and/or Bldg 32 (TBD)	5/97	to ASTER GDS: TBD to TBD DAAC: TBD
LPS	EDC	TBD	to EDC DAAC: 50 Mbps
SMC	Bldg 32	7/96	to DAACs: 64 Kbps

* ECS need date for Release A

** Rates required for AM1 full performance support

Release B Interfaces

- DAAC - Distributed Active Archive System
- EOC - EOS Operations Center
- FSTB - Flight Software Testbed
- GSE - Ground Support Equipment
- SAS - Spacecraft Analysis System
- SDF - Software Development Facility
- SSIM - Spacecraft Simulator



Release B Interface Description

System	Release B Location	Need dates*	Data Rates
JPL DAAC	JPL	4/97	to GSFC DAAC: 20 Kbps
ASF DAAC	ASF	4/97	to Other DAACs: 5 Kbps
NSIDC DAAC	NSIDC	4/97	to EDC DAAC: 170 Kbps
FSTB	Bldg 1	6/97	to EOC: 56 Kbps
GSE	Valley Forge, PA	1/98 to launch	to SAS: 56 Kbps
SAS	Bldg 32	6/97	to EOC: 512 Kbps
SSIM	Bldg 32	6/97	to EOC: 512 Kbps
SDF	Valley Forge, PA	6/97 to launch	to EOC: 512 Kbps to SAS: 56 Kbps

*ECS Need dates are for Release B

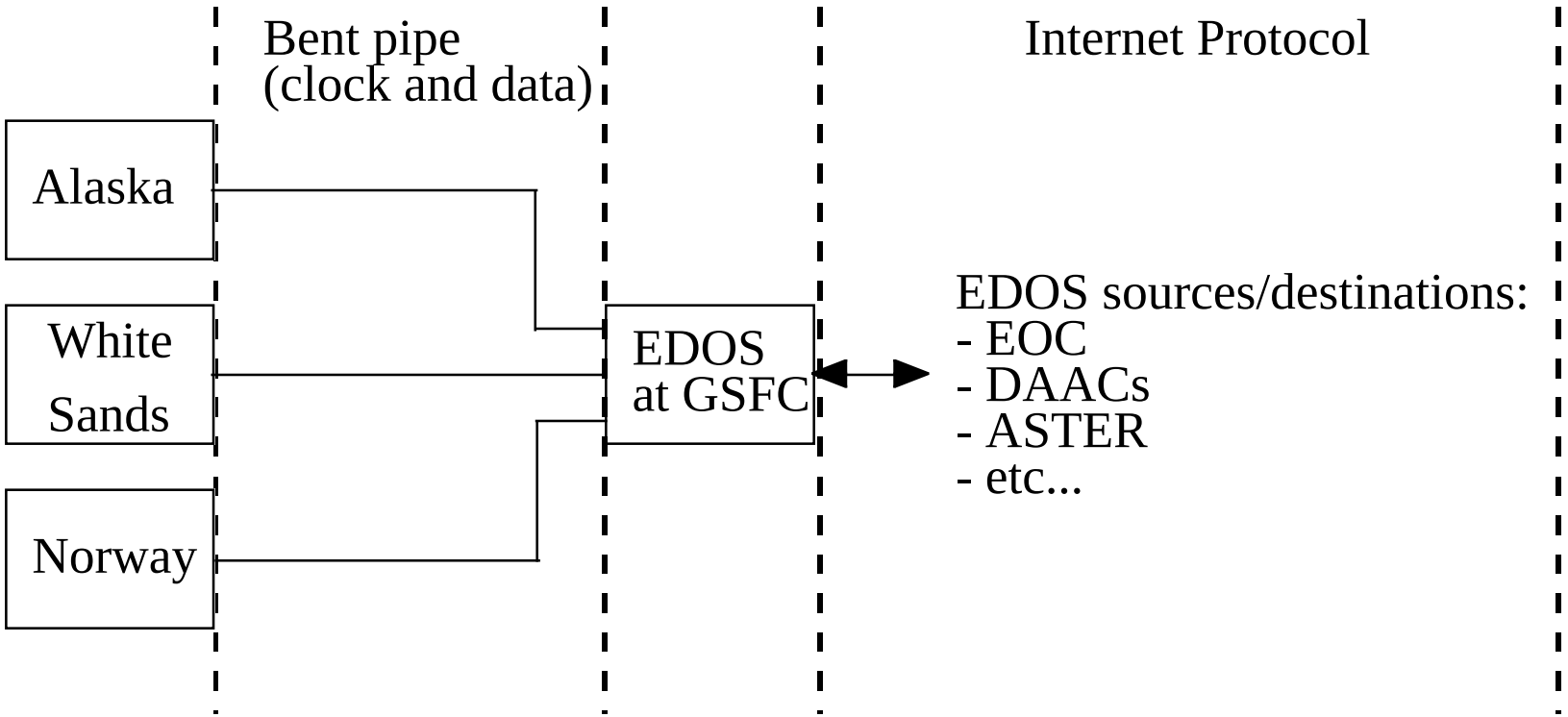
ICD Need Dates

- Interface Control Document (ICD) need dates are driven by system Critical Design Review (CDR) for each supported system
- EOSDIS Core System (ECS) Release A CDR (DAACs and SMC), EOC CDR, TSDIS CDR have all occured
  - The EOC and TSDIS ICDs are priority items
- ECS Release B CDR (DAACs and SMC) occurs in mid April
  - All ECS ICDs will be final at that time
- ASTER GDS CDR occurs in late January
- ETS CDR is TBD
- LPS CDR is in November
- Lockheed-Martin element CDRs are as follows:
  - SCS, SDF, FSTB, GSE: already occured
  - SSIM: July 1996
  - SAS: September 1996

II. D. Adaptive Downlink Architecture

Chris Garman

Adaptive Downlink Architecture



Adaptive Downlink Characteristics

- Assumed that EDOS source of both real time and science IP data is at GSFC
- Provision of bent pipe service for both real time and science data from White Sands Complex (WSC), Alaska, and Norway
- Bent pipe services are dedicated full term (no scheduling system is needed.)
- Studies continue with potential impacts to the following interfaces:
  - EDOS: Potential for real time (RT) IP source at WSC
  - ASTER GDS: If RT source moves to WSC, changes current design
- Nascom has tasked GE Americom to run a test of the Intelsat link to Norway
  - Plans are to use an earth station in Holmdel, NJ
  - First test results scheduled to be delivered mid December 1995

III. A. EBnet Topologies

Lynn Disque

Overview

- Topology Update
- Topology Implementation Strategy
- V0 Network
- EBnet Supporting TRMM
- EBnet 1999

Topology Update

- Topologies reflect Adaptive Downlink and Subsetting Assumptions provided by the ESDIS Project
  - EDOS at GSFC
  - Traffic reduced by approximately 70% for GSFC to LaRC and GSFC to EDC flows
- IP Real-Time
  - Only two locations, GSFC and Japan
  - One-minute Mean Time To Restore Service (MTTRS)
  - Redundant equipment and circuits
  - Goal, use ISDN for dial back-up to Japan
- IP Science Network
  - Science network reduced by subsetting
  - No redundancy
  - Four-hour MTTRS

Topology Implementation

- Science Network developed from V0 Network
  - Nascom circuits replacing Program Support Communications Network (PSCN) circuits [Federal Telecommunications System (FTS) 2000 circuits]
  - FTS 2000 available circuits: 64K, Fractional T1, T1, T3
- Circuit phase-in approach; just in time
  - For early testing, providing basic connectivity at a reduced rate
  - Add bandwidth as needed

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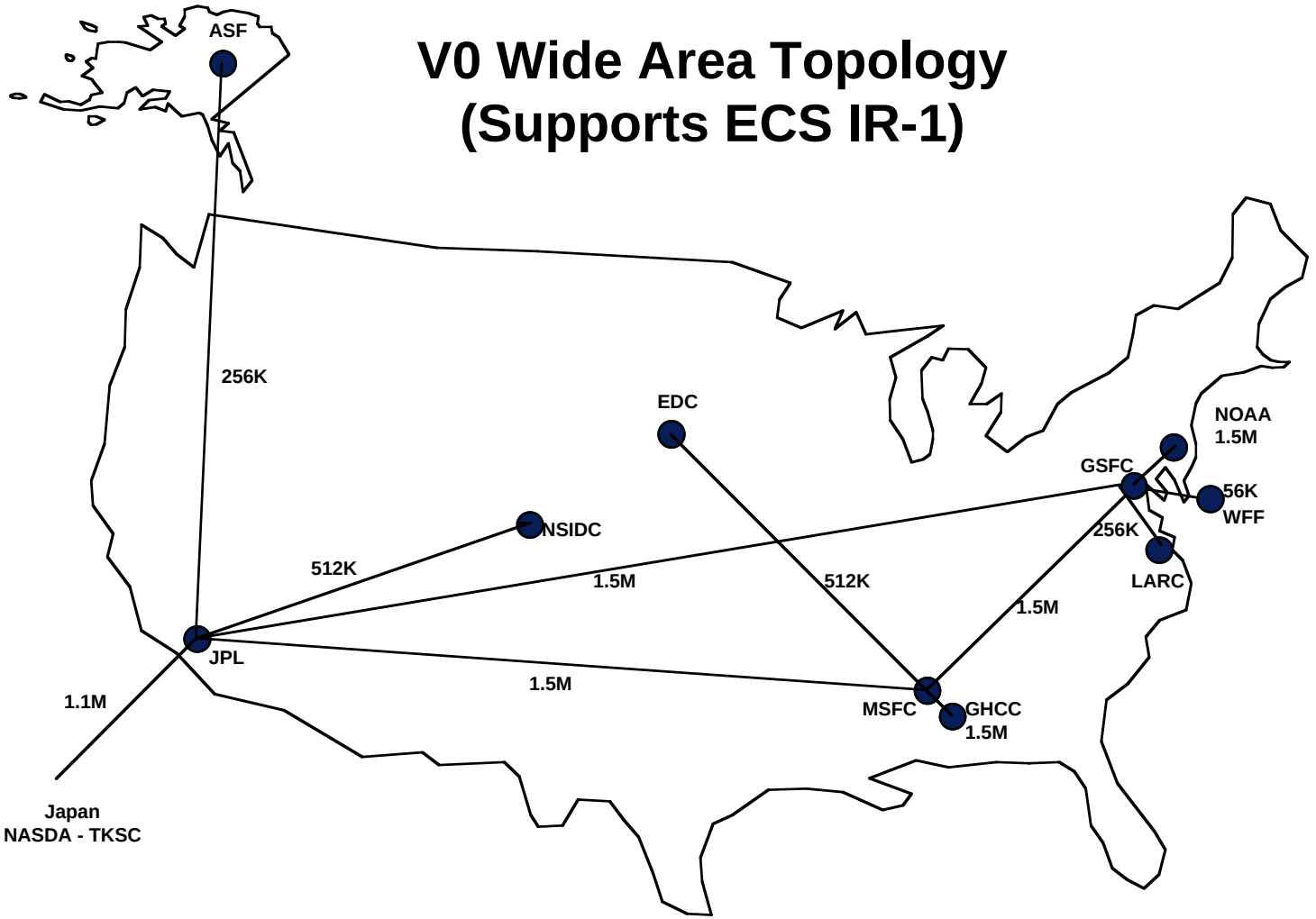
EBnet TRMM Review

V0 Wide Area Topology (Supports ECS IR-1)



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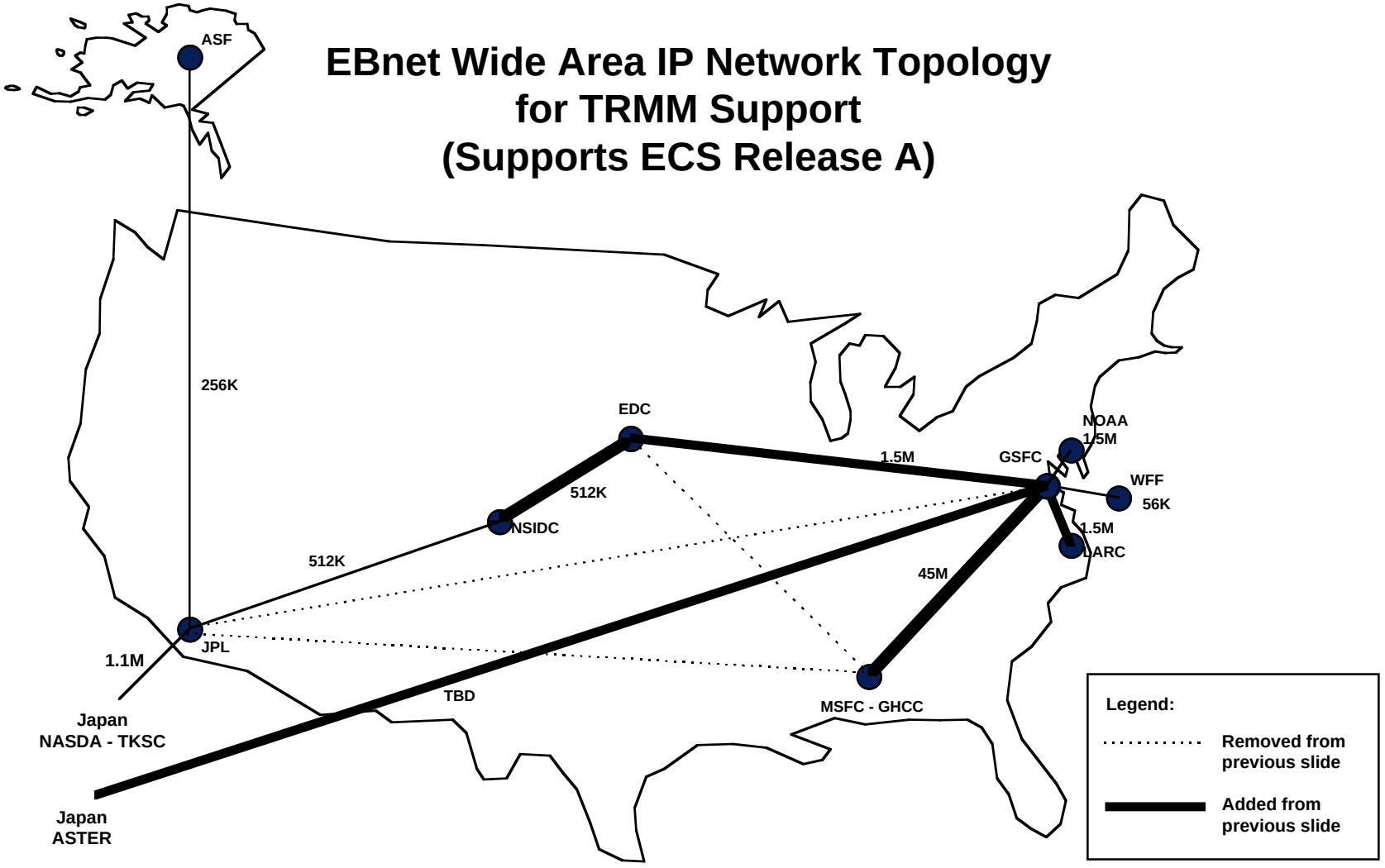
EBnet Wide Area IP Network Topology for TRMM Support (Supports ECS Release A)



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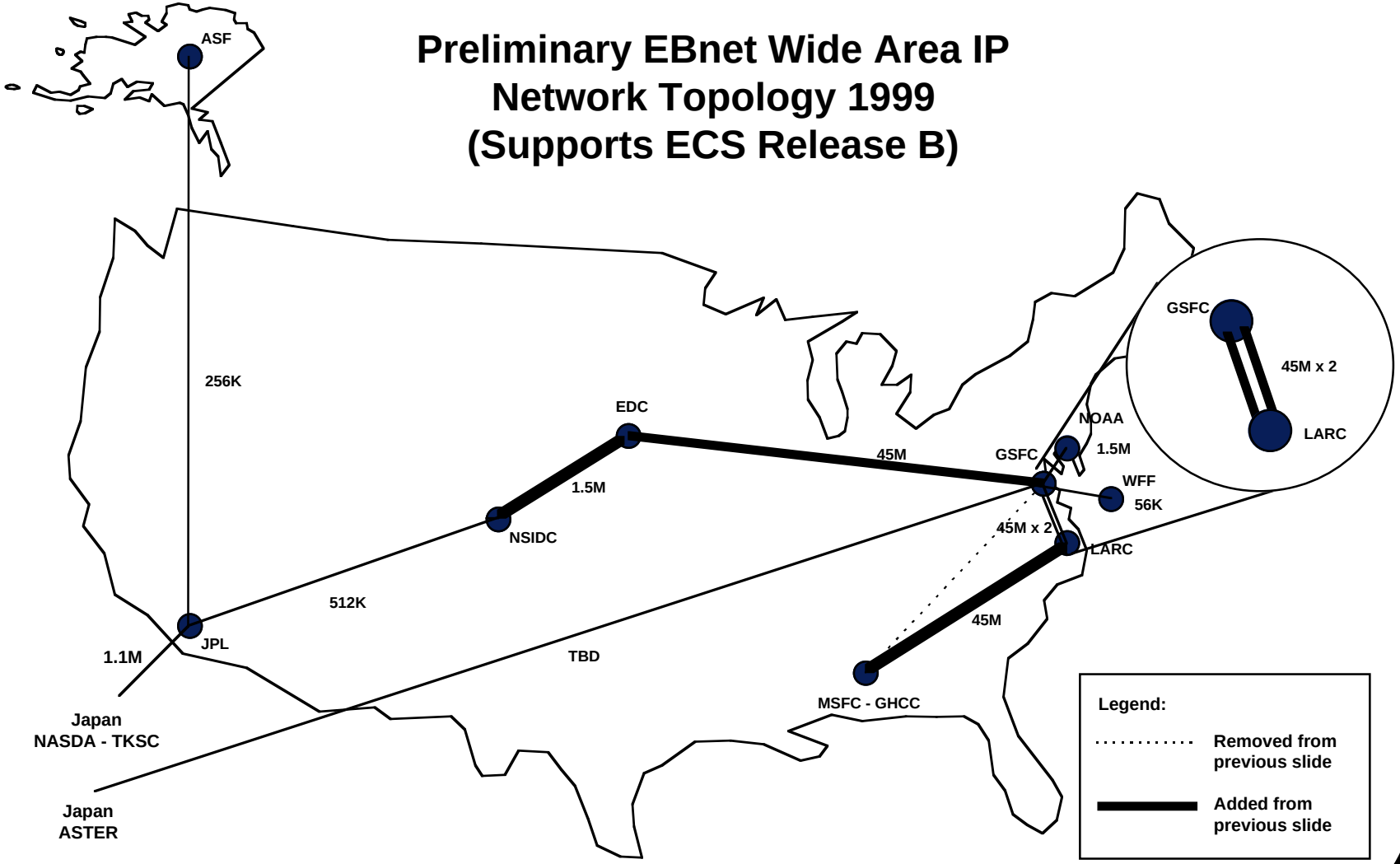
EBnet TRMM Review

Preliminary EBnet Wide Area IP Network Topology 1999 (Supports ECS Release B)



III. B. Network Routing/Addressing

Chris Garman

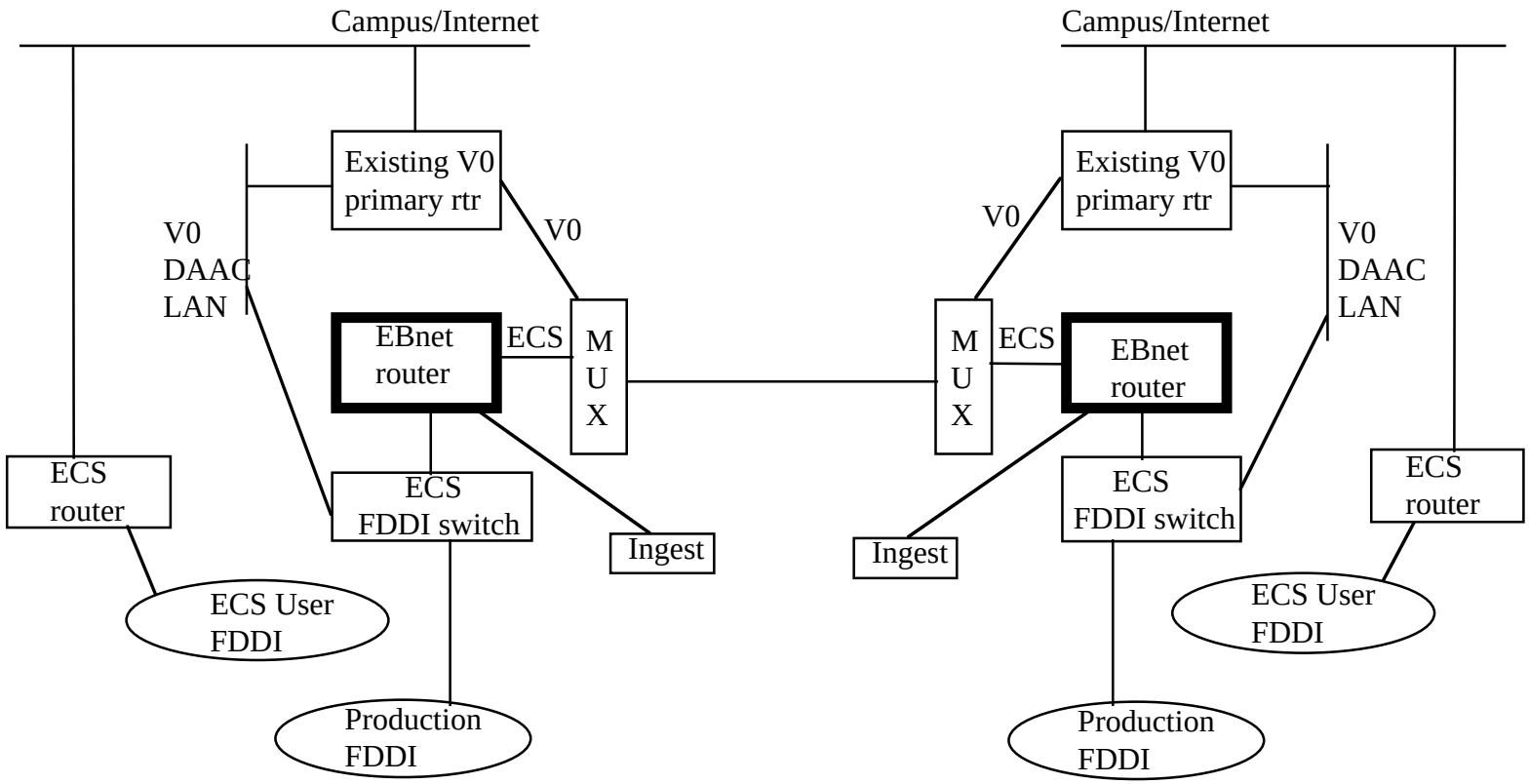
Addressing/Routing issues

- A block of 32 Class C addresses has been requested by Nascom from NASA Science Internet (NSI)
- Open Shortest Path First (OSPF) will be used on the EBnet WAN backbone
- Border Gateway Protocol (BGP) (and Routing Information Protocol [RIP]) will be used between EBnet and other networks (e.g. ECS, NSI, Program Support Communication Network Internet [PSCNI], Version 0 [V0], TSDIS)
- Assumption: Current V0 network addresses will be retained for legacy usage
- Security: No EBnet network addresses will be advertised by EBnet outside EBnet
- Source address filtering may be used where required

III. C. Site Designs

Chris Garman

Generic EBnet site design



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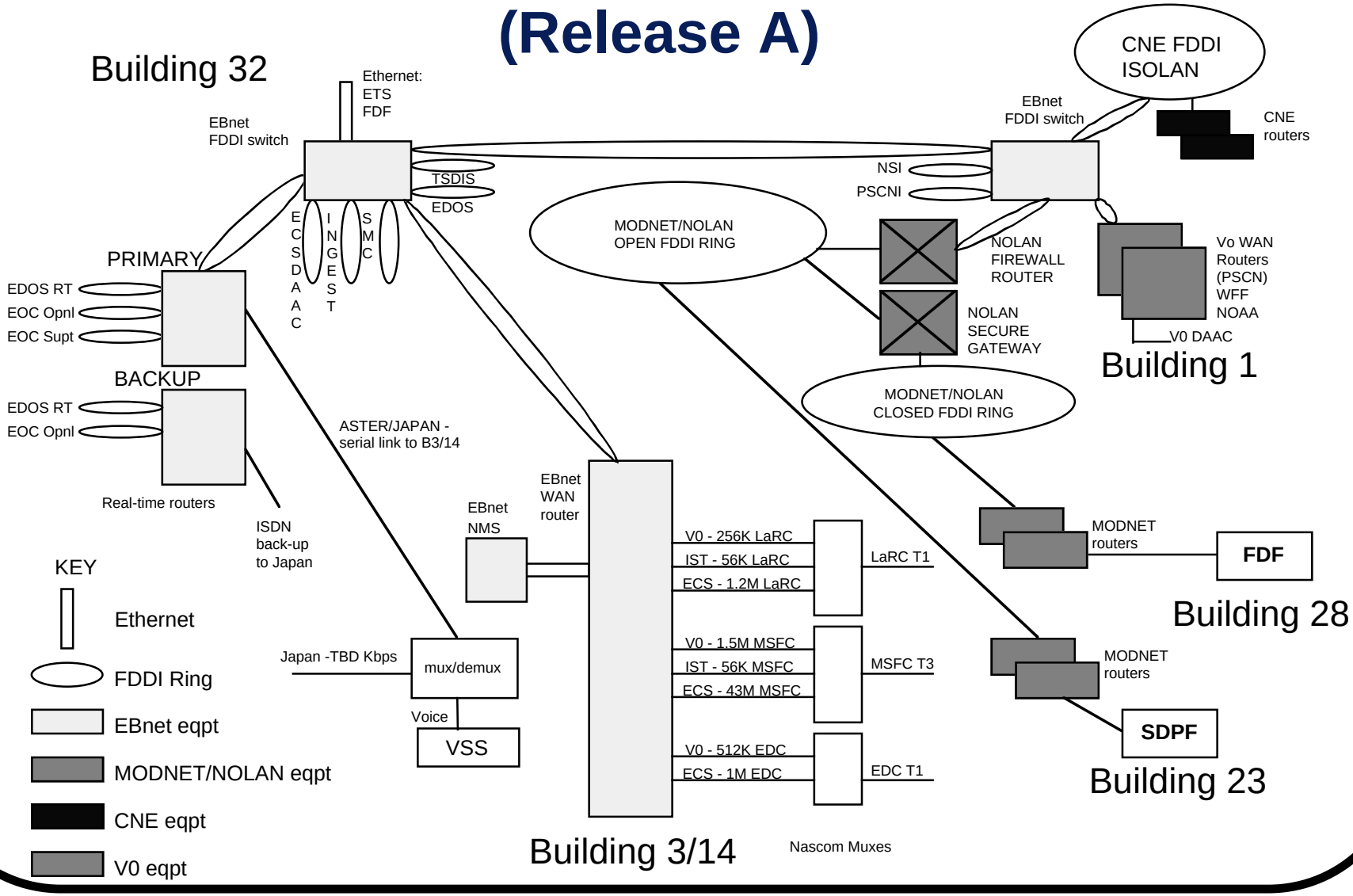
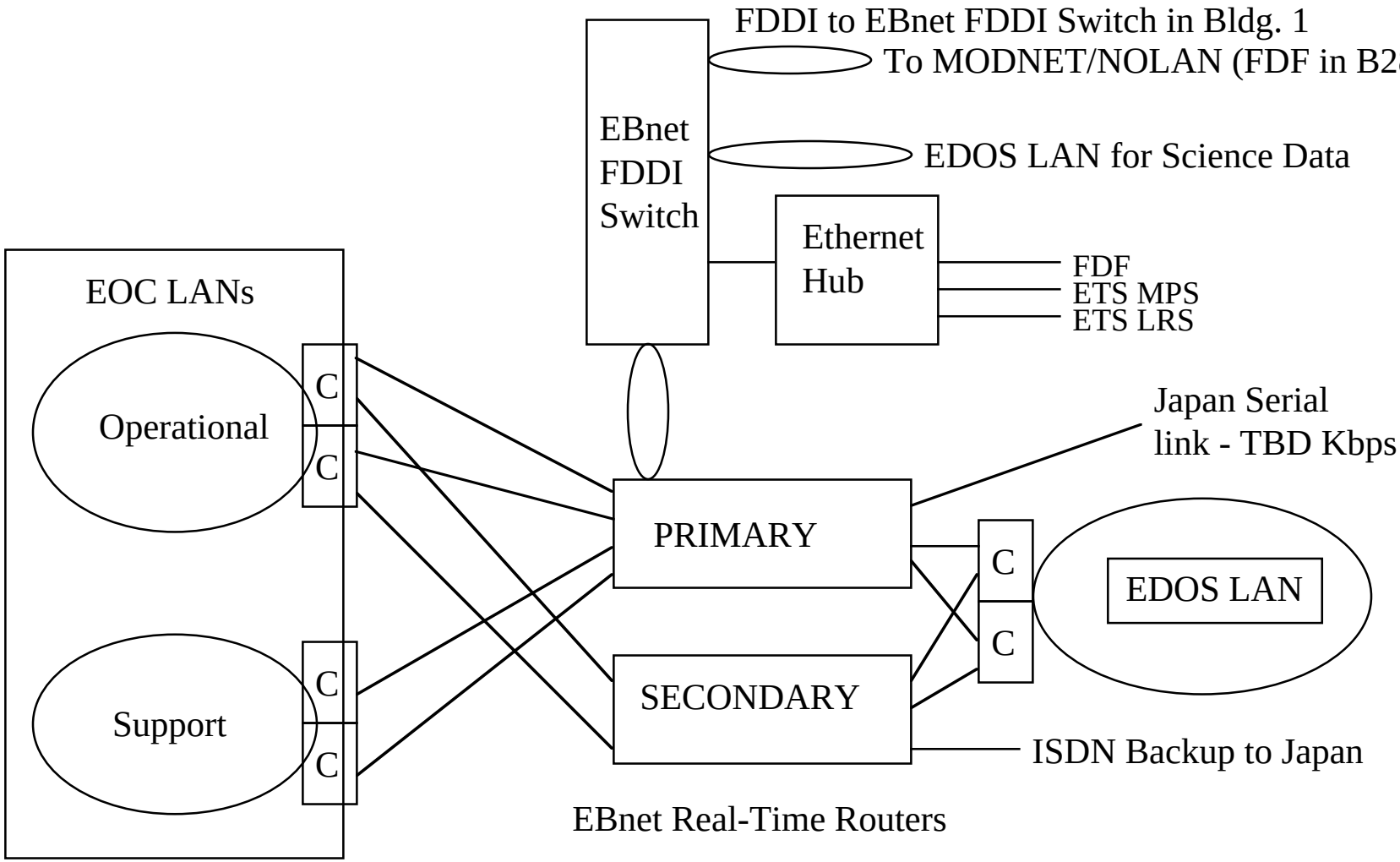
GSFC Site Design for TRMM Support (Release A)



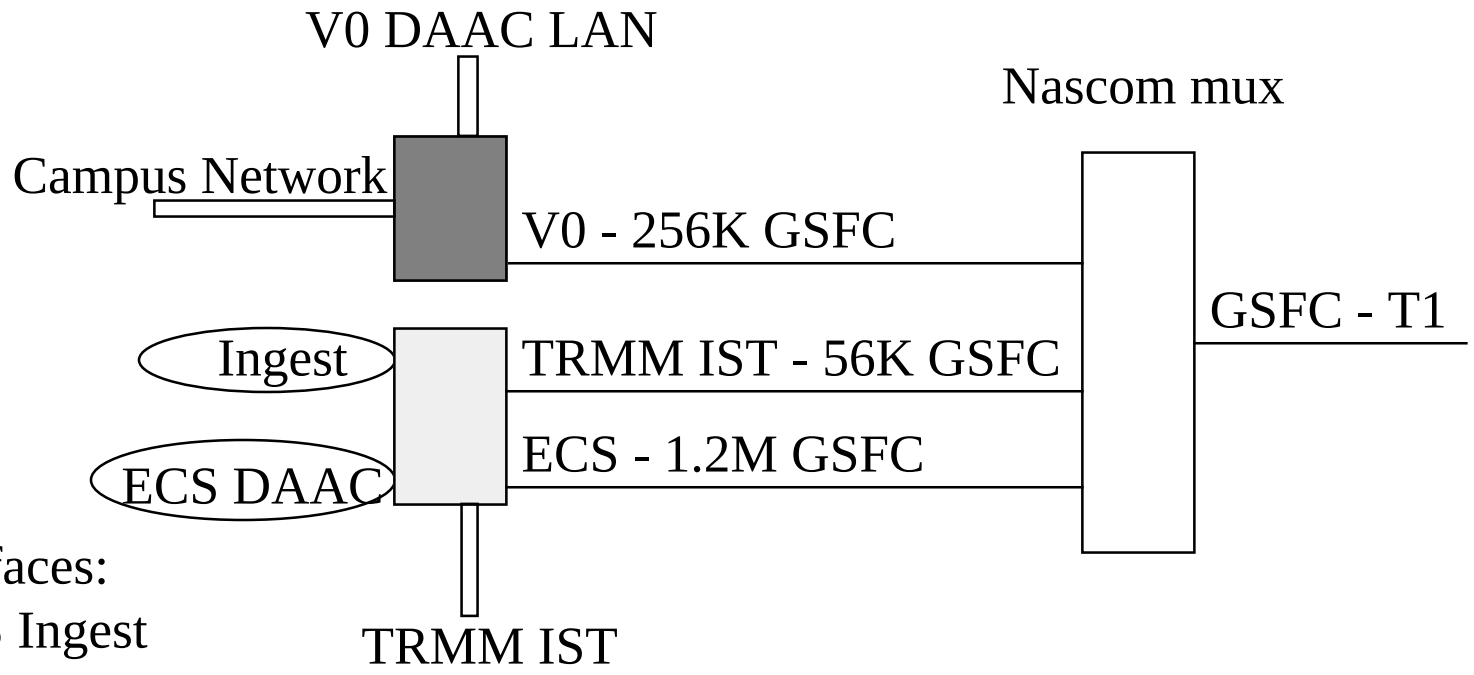
EOC Interface Design for Release A



EBnet

EBnet TRMM Review

LaRC Release A Design



EBnet Interfaces:
FDDI - ECS Ingest
FDDI - ECS DAAC
Ethernet - TRMM IST

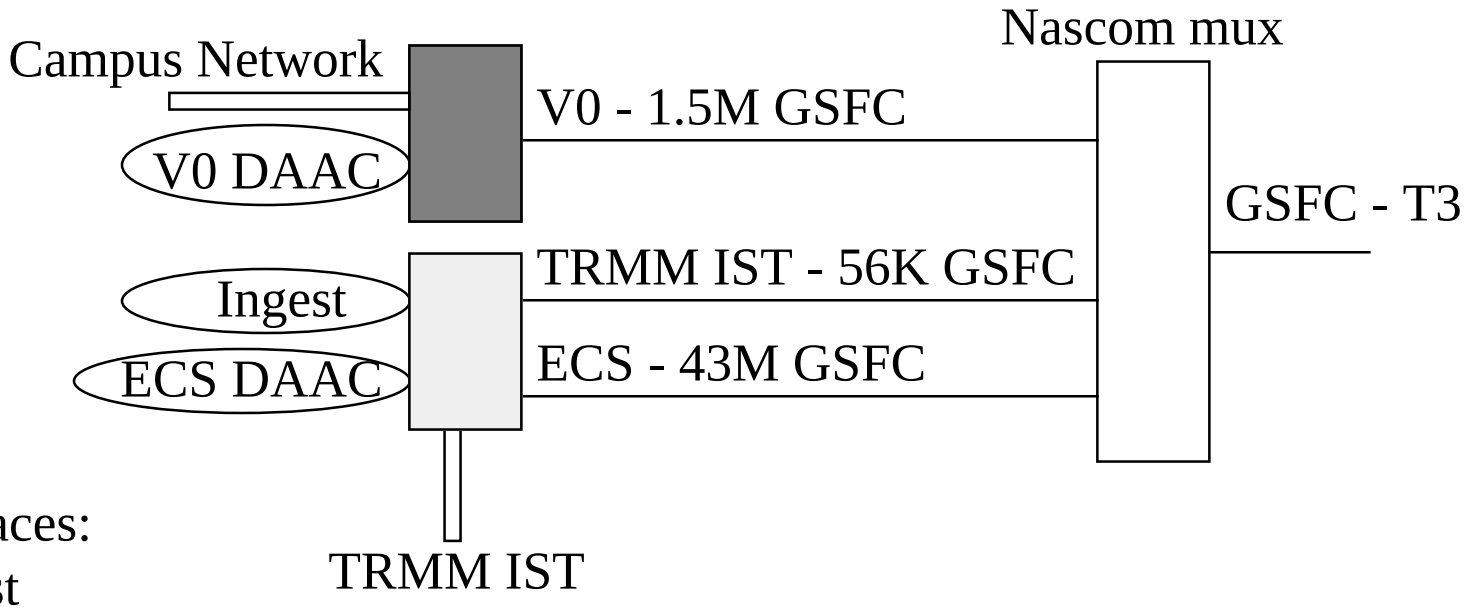
Nascom
Serial Lines:
GSFC - T1

V0 router

EBnet router

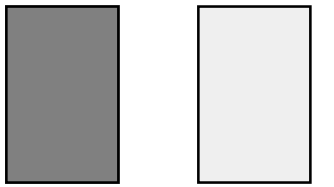
MSFC - GHCC Release A Design

(GHCC - Global Hydrology Change Center)



EBnet Interfaces:
FDDI - Ingest
FDDI - ECS DAAC
Ethernet - TRMM IST

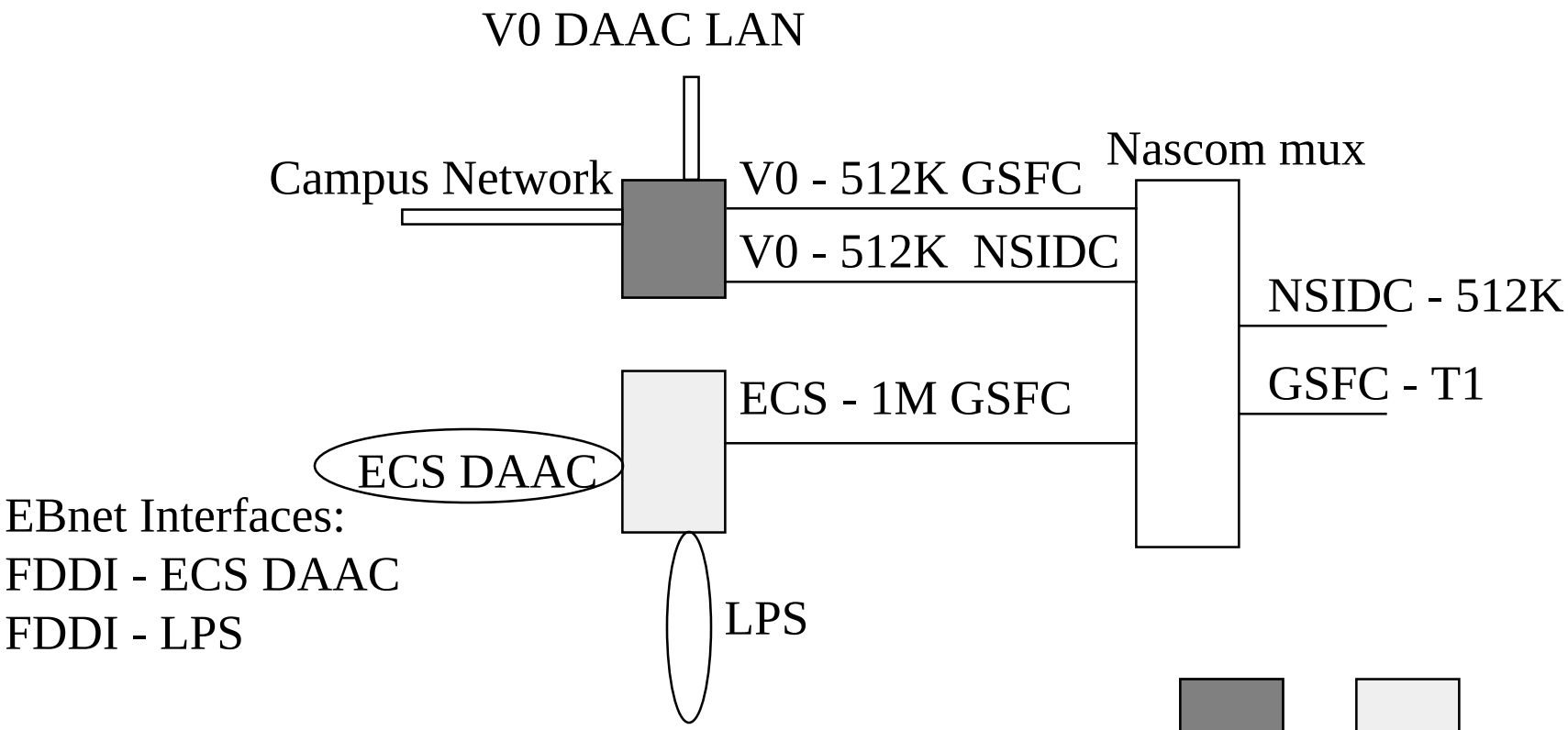
Nascom
Serial Lines:
GSFC - T3



V0 router

EBnet router

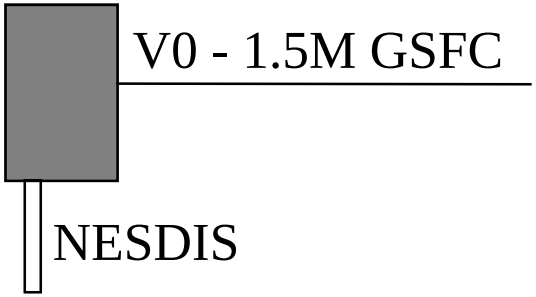
EDC Release A Design



EBnet Interfaces:
FDDI - ECS DAAC
FDDI - LPS

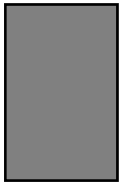
Nascom
Serial Lines:
GSFC - T1
NSIDC - 512K

NOAA Release A Design

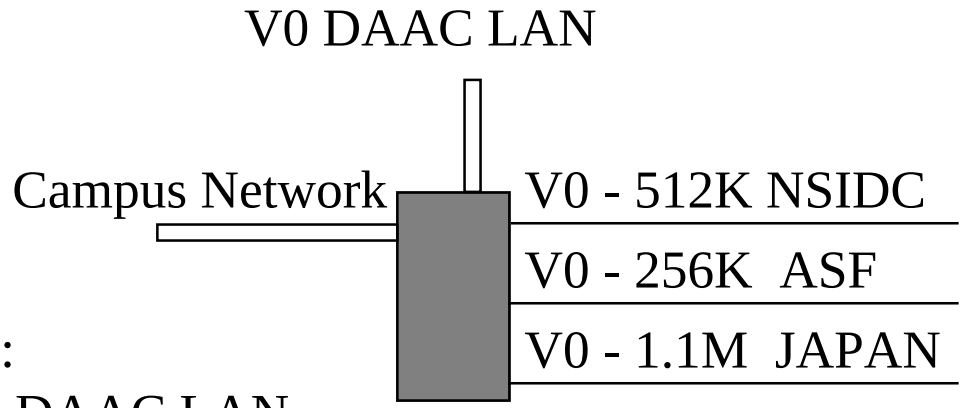


V0 Interfaces:
Ethernet - NESDIS

PSCN
Serial Line:
GSFC - T1



JPL Release A Design



V0 Interfaces:
Ethernet - V0 DAAC LAN
Ethernet - Campus Network

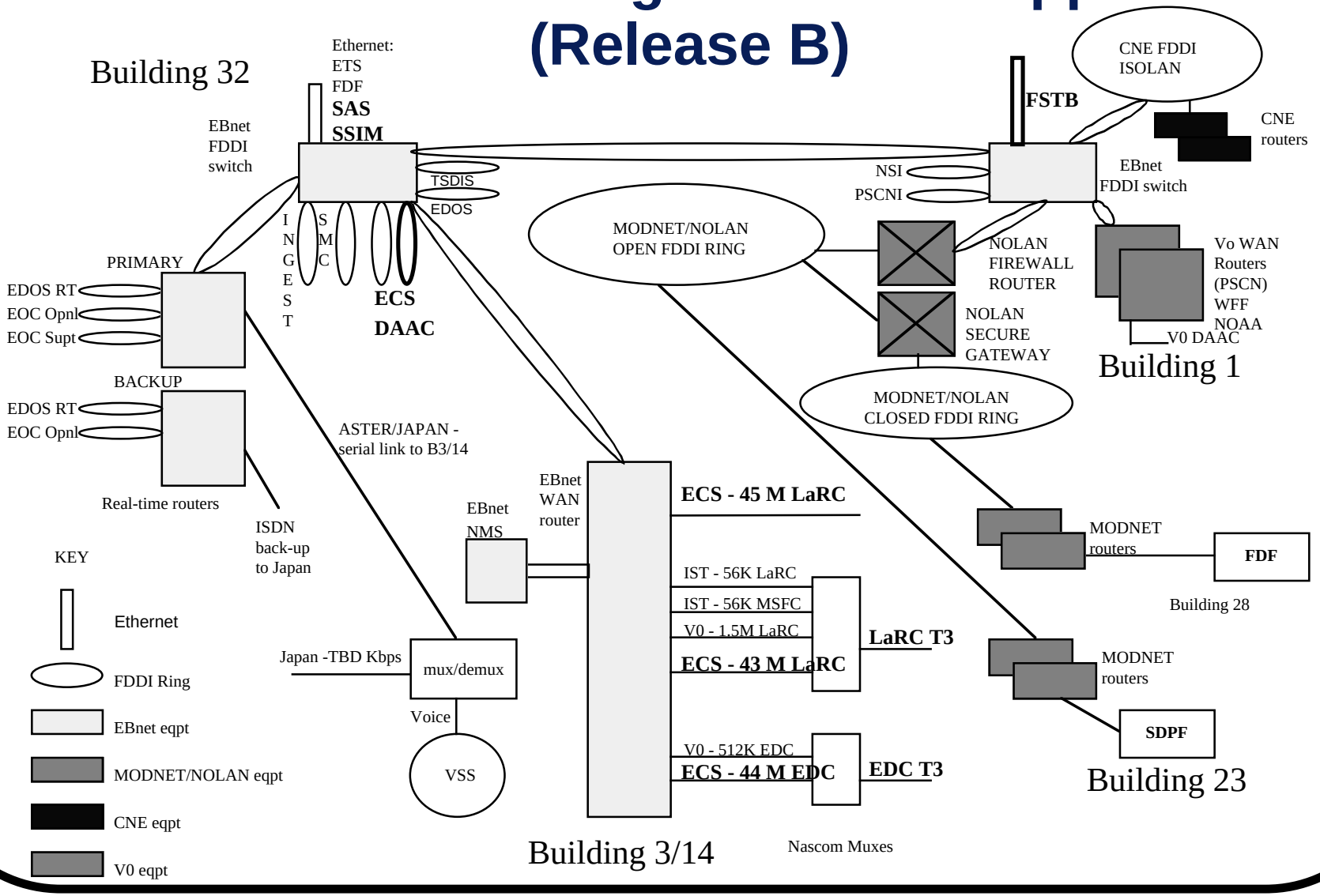
PSCN
Serial Line:
ASF: 256K
NSIDC - 512K
Japan - 1.1M

V0 router

EBnet

EBnet TRMM Review

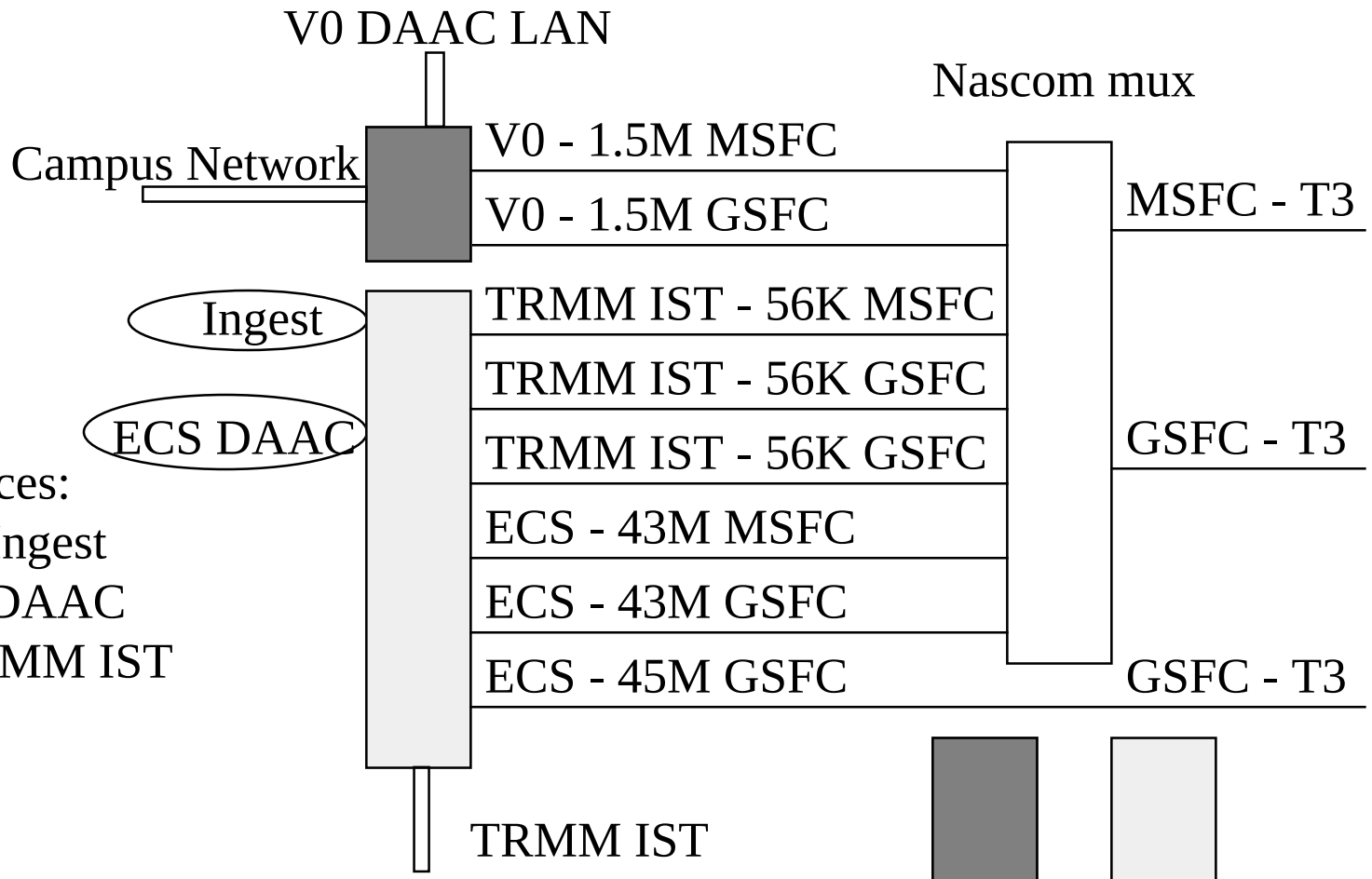
GSFC Site Design for AM1 Support (Release B)



EBnet

EBnet TRMM Review

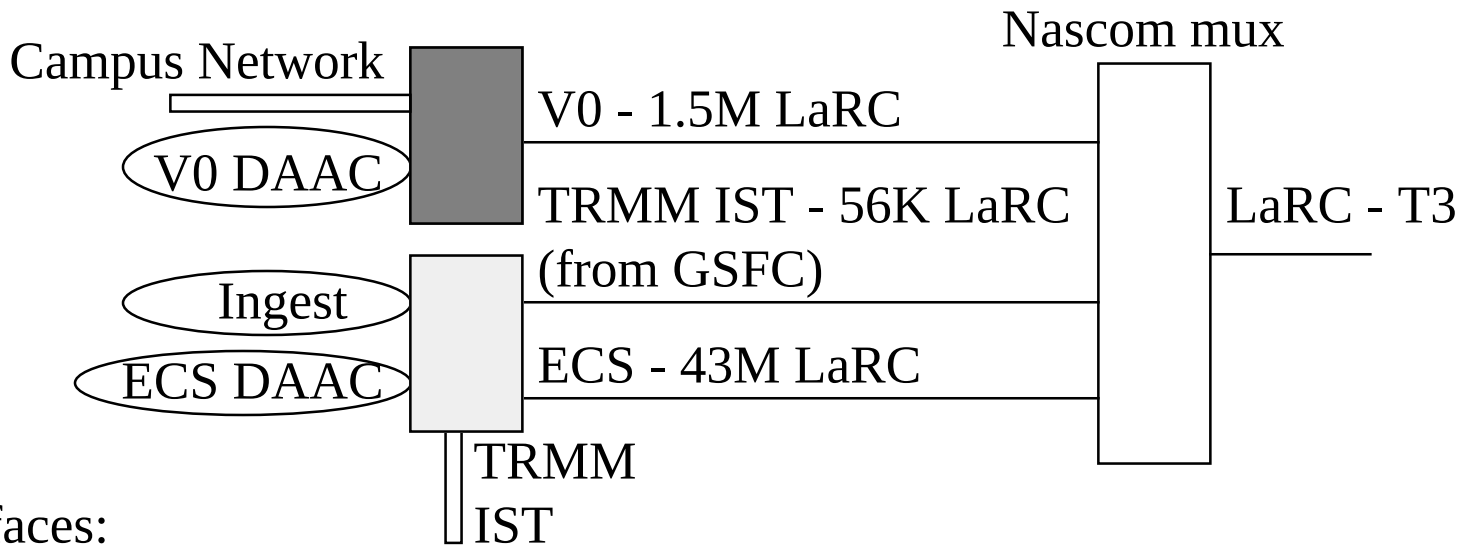
LaRC Release B Design



EBnet Interfaces:
FDDI - ECS Ingest
FDDI - ECS DAAC
Ethernet - TRMM IST

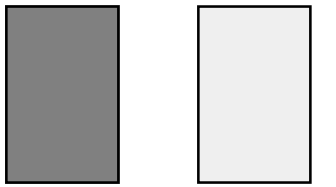
Nascom
Serial Lines:
GSFC - 2xT3
MSFC - T3

MSFC - GHCC Release B Design



EBnet Interfaces:
FDDI - Ingest
FDDI - ECS Switch
Ethernet - TRMM IST

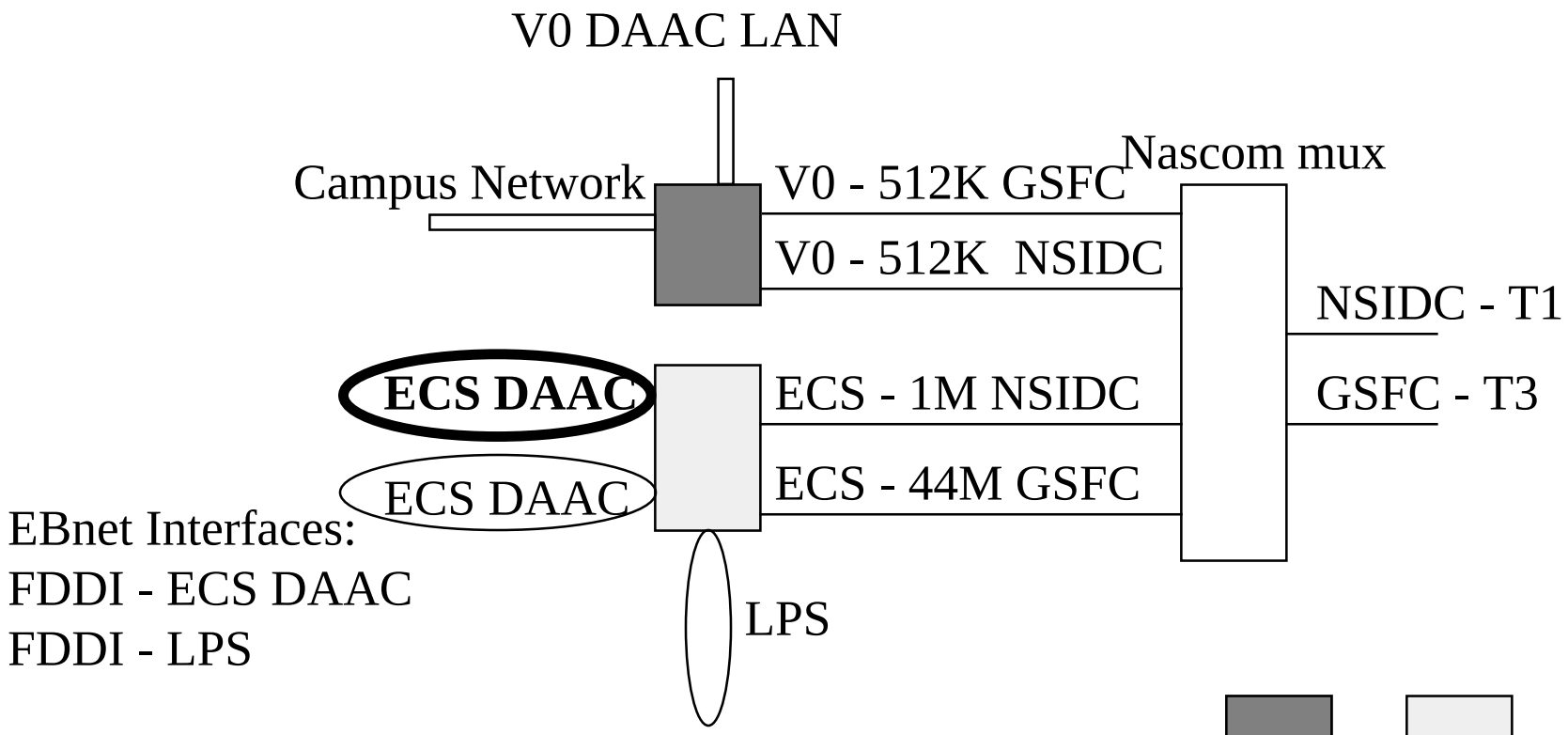
Nascom
Serial Lines:
LaRC - T3



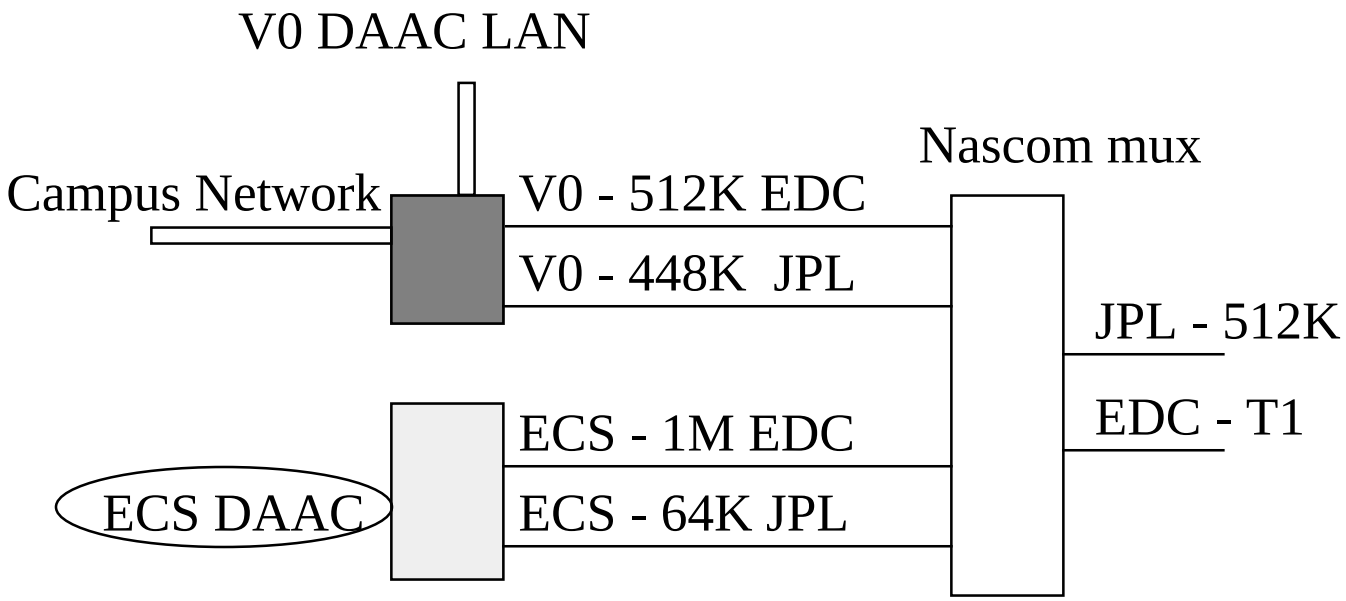
V0 router

EBnet
router

EDC Release B Design



NSIDC Release B Design



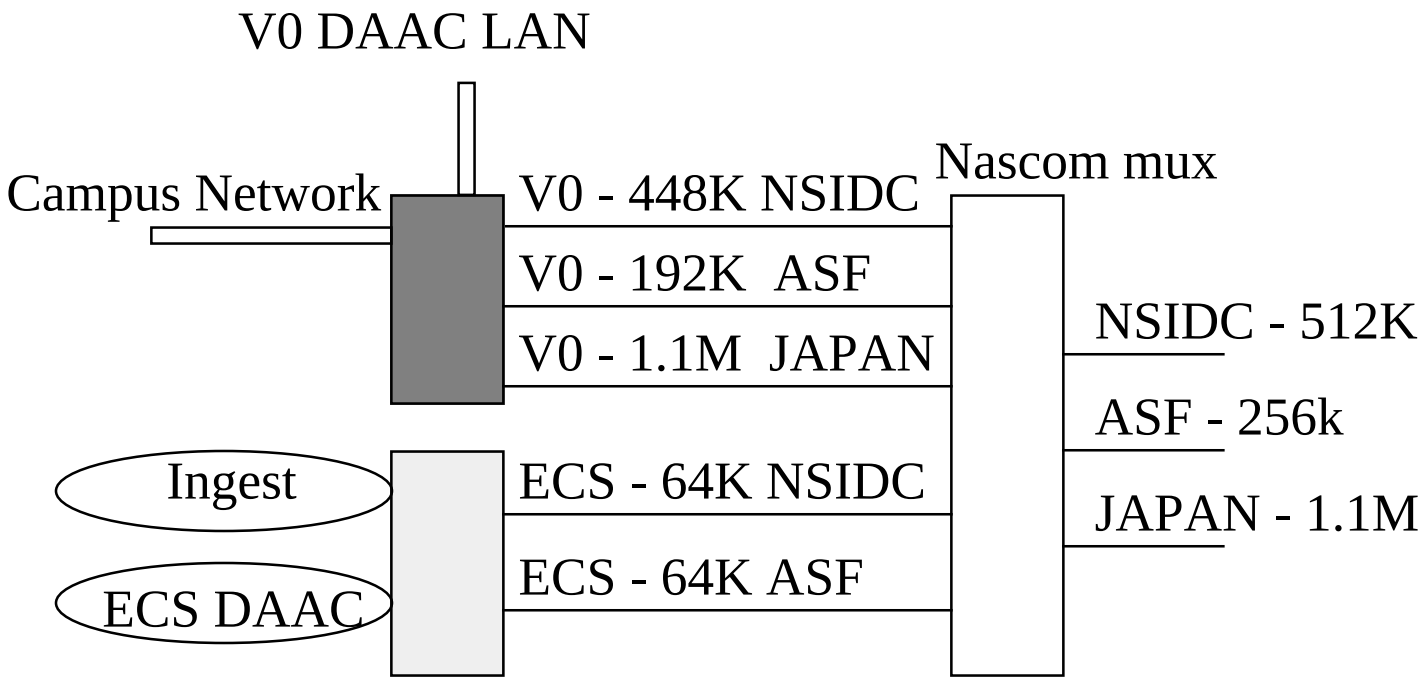
EBnet Interfaces:
FDDI - ECS DAAC

Nascom
Serial Lines:
EDC - T1
JPL - 512K

V0 router

EBnet
router

JPL Release B Design



EBnet Interfaces:
FDDI - Ingest
FDDI - ECS DAAC

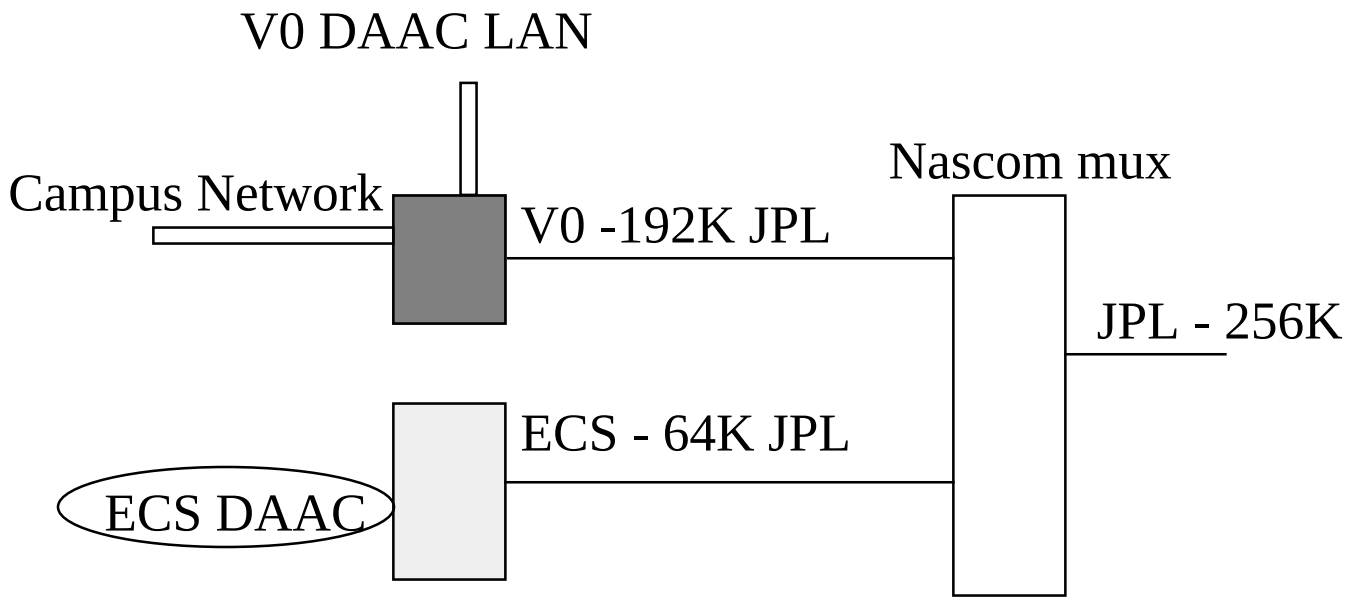
Nascom
Serial Lines:
ASF - 256k
NSIDC - 512K

PSCN
Serial Lines:
JAPAN - 1.1M

V0 router

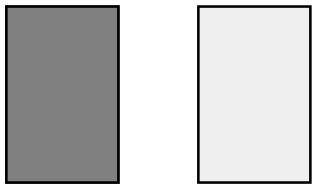
EBnet router

ASF Release B Design



EBnet Interfaces:
FDDI - ECS DAAC

Nascom
Serial Lines:
JPL - 256K



V0 router

EBnet router

III. D. Site Visits

Chris Garman

Site Visits

- Site visits are needed for three reasons
  - Meet and greet existing V0 users
  - Review network troubleshooting procedures with site personnel
  - Establish contact with site personnel in preparation for EBnet equipment installs
- Site visit to ASF will also provide opportunity for survey in support of adaptive downlink domsat requirement
- Current Schedule
  - NOAA: November 1995
  - ASF: November 1995 (slip to February 1996 if funds unavailable)
  - LaRC: December 1995
  - MSFC: December 1995
  - EDC: January 1996
  - JPL: February 1996

III. E. Testing

Paul Sullivan

Testing

- EBnet Test Program
- EBnet Internal Test Strategy
- EBnet External Test Strategy

EBnet Test Program

- Consists of both internal testing and support to external testing activities
- Internal testing program is comprised of:
  - Validating design functionality and performance
  - Verifying EBnet Requirements, Volume 6
  - Performing acceptance testing
- External test support include:
  - EOSDIS Sister Project (e.g., ECS, EDOS) Testing
  - Mission Readiness Test Team (MRTT)
  - TRMM and Landsat-7 Project Testing
  - Independent Verification and Validation (IV&V)and System Integration and Test (SI&T)

EBnet Internal Test Strategy

- Internal testing consists of:
  - Early TRMM Test: Perform design validation of GSFC, LaRC and MSFC node upgrade using existing NOLAN/V0 test procedures
  - EBnet Release A Test: Perform consolidated System Test to address design validation, requirements verification and acceptance testing on EBnet Release A network (GSFC, LaRC, MSFC and EDC)
  - EBnet Release B Test: Perform testing of new features in a similar manner as EBnet Release A
- Test Approach:
  - Use combined NASA/ATSC/CSC/BA&H Test Team
  - Tailor existing Ecom Test Plan and NOLAN/V0 test procedures; System Test Plan to be delivered at EBnet AM-1 Review
  - Use existing EMAT test equipment (e.g., protocol analyzer) as required
  - Perform joint testing with users (e.g., EDOS, ECS, TSDIS, etc.) to the maximum extent possible

EBnet External Test Strategy

- EBnet support appears applicable to the following tests:
  - TRMM Early Test: TRMM MRTT, ECS IR1, IV&V IR1 Component, SI&T Test Version
  - Release A: TRMM and Landsat-7 MRTT, TSDIS and TRMM, Landsat-7 Projects, EDOS Version 2, ECS Release A, IV&V Release A Component, SI&T Version 1
  - Release B: EDOS Version 3, ECS Release B, IV&V Release B Component, SI&T Version 2
- EBnet support requirements envisioned include:
  - Test planning: Attend Landsat-7 and TRMM MRTT and other test meetings; participate in ESDIS SI&T activities; review various test plans/procedures
  - Common Carrier Circuit: Provide required EBnet circuits to support testing; various test organizations contacted; information being analyzed and any new requirements being placed in EBnet Traffic Database
  - Operations: Ensure EBnet network is available for testing efforts

III. F. Network Management System Design for TRMM

Joe Dagher

Network Management System

- Network Management System Overview
- Planned Enhancements

System Overview

- The existing NOLAN/V0 network management system is providing support for IR1 testing
- HP Openview Network Node Manager (NNM)
  - Perform stats collection using SNMP
  - Periodically polls network device, (i.e. routers, hubs, etc.) and generates traps in the event of a network problem
- ISICAD Assets Management Software
- In-house developed scripts and utilities
  - Alarm notification and logging
  - error logging
- Prime and Backup Management Stations

Planned Enhancements

- Upgrade the Prime Management Station by the end of 11/95
  - Hardware upgrade to a HP9000/735
  - Upgrade NNM software to Version 3.31
- The Backup Management Station was delivered at that revision level

III. G. Network Management System Design for AM-1

Karen Petraska-Veum

Overview

- Network Management System Goal
- Implementation approach
- Network management system overview
- Design status
- Transition schedule

Network Management System Goal

- Enhance and extend the capabilities of the existing NOLAN/ V0 network management system to provide better network and problem management capabilities, automate information exchange and provide a consistent interface with other elements of ECS

Implementation Approach

- Phased implementation
  - Design and integrate in small pieces
  - Minimize customization from the outset through the extensive use of COTS
- System release in multiple deliveries
  - Prioritize functions for each delivery
  - Leverage on market trends
- Continue network management product testing and evaluation capability within EMAT
- Keep the system simple; operators will use it, not engineers

Implementation Plan

- Delivery I, 2/1/96
  - Integrate Simple Network Management Protocol (SNMP) management system with a reporting engine
  - Use trouble ticketing system integrated with a relational database management system
  - Provide interface to SMC
- Delivery II, 5/1/96
  - Add physical management and remote monitoring (RMON) probes
  - Integrate trouble ticketing system with SNMP manager
  - Select and implement out-of-band management system
  - Consider other 3rd party applications
- Delivery III, TBD
  - Continue to refine the system

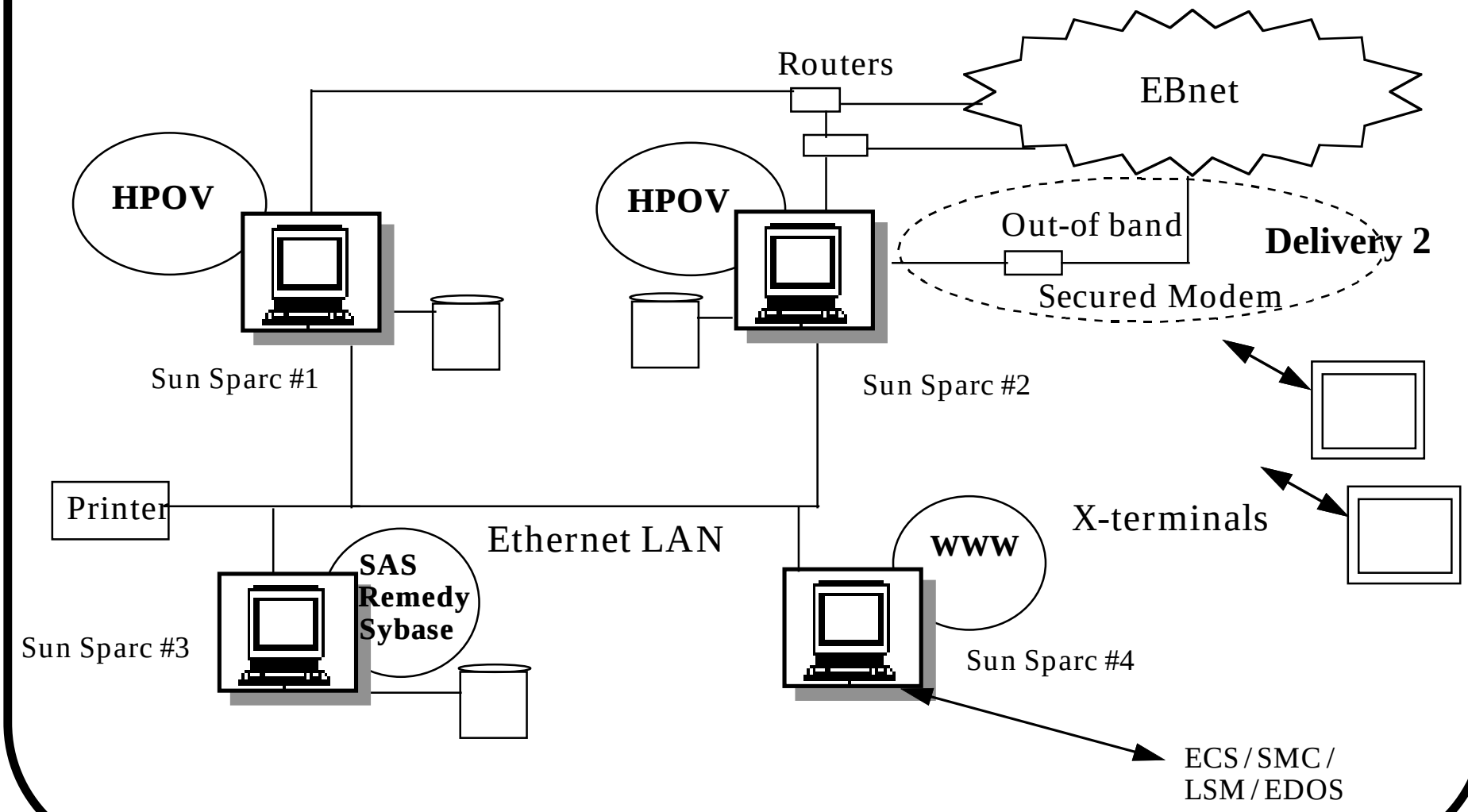
NMS Overview
Delivery 1

- HP OpenView Network Node Manager
- Remedy Action Request System (Trouble ticketing)
- Sybase System 10 (Relational database management system with SQL)
- Statistical Analysis System (SAS)(Report generation and performance analysis)
- CERN http server (Information dissemination via WWW)

EBnet

EBnet TRMM Review

NMS Configuration



Design and Implementation Status

- NOC Sun workstations and printers installed and configured
- HPOpenView, SAS, Sybase, Remedy installed and configured on production systems in lab
- Remedy ARS schema and workflow rules developed
- SAS and Remedy report generation in progress
- Script generation in progress for customization of HPOV
- EBnet-ECS SMC interface design work in progress
- Begin evaluating selected 3rd party applications
- Operations team to be assembled and trained in following months
- Operations facilities being readied
  - NOC design completed
  - Furniture order in progress

Transition Schedule

- NOLAN/V0 NMS will be the only network management system used until Delivery 1 of EBnet NMS
- Shadow manage NOLAN/V0 NMS with EBnet NMS (March 1996)
  - Exercise system, evaluate, provide feedback, remove bugs
- EBnet NMS becomes primary, shadow manage with Nolan/V0 NMS (May 1996)
  - NOLAN/V0 NMS available in case problem is identified
- Eliminate NOLAN/V0 NMS. EBnet NMS functions as primary without shadow. (July 1996)

IV. A. Operations Concept for TRMM

Dave Yoest

High Level Operations Concepts TRMM IR-1

- Staffing
- Roles and Responsibilities
- Escalation Process
- Operations Policy
- Maintenance Policy
- Sustaining Engineering

Staffing

- In the Nascom Operational Area
  - Comm Manager (24x7 on site)
  - Nascom Operators (24x7 on site)
- At GSFC
  - Technicians/engineers from Modnet/Nolan (8x5 on site, 24x7 on call)
- At other DAAC sites
  - Non-EBnet support staff at site assisting as a courtesy
  - Phone support by GSFC personnel (24x7)
  - GSFC staff may travel to remote site if necessary
- Sustaining Engineering
  - Modnet/Nolan engineers at GSFC (8x5 on site)

Roles and Responsibilities

- Nascom Operators
  - Monitor network map
  - Report faults to Comm Manager
- Comm Manager
  - Primary contact for problem reporting
  - Interface with technicians and engineers to relay the problem
- NOLAN technical staff
  - Sustaining engineering support
  - Diagnostic and troubleshooting
  - Shadow network monitoring (8x5)

Escalation Process

- First tier: NASCOM Comm Manager (notified by operators or DAAC site personnel)
- Second tier: NOLAN technical staff
- Third tier: NOLAN engineering staff
- Fourth tier: Vendor maintenance and technical troubleshooting agreements

Operations Policy

- Interface with other organizations via voice communications and electronic mail
- No automated exchange of network operations or status data
- Comm Manager is the single point of contact in the Nascom network

Problem Resolution Scenarios

- Problem alert via operator observation, HPOpenView alarm, trouble call, or Comm Manager.
- Comm Manager opens trouble ticket and refers problem to technical staff
- Technical/engineering staff keep Comm Manager informed of status
- Technical staff troubleshoots to isolate and resolve problem
- Technical staff involves engineering staff if problem cannot be isolated or resolved
- Procedures for resolving different types of problems
  - Local hardware failure resolved by replacing faulty parts with spares
  - Assistance is requested from remote site courtesy contacts for remote hardware failure
  - Carrier is involved if problem is circuit failure
- Comm Manager is notified of problem resolution and closes trouble ticket

Maintenance Policy

- Spares
  - Primary and backup hardware is installed
  - GSFC staff will work with DAAC site staff (who provide assistance as a courtesy) to provide fault determination/isolation
  - Spare parts will be shipped to site overnight
- “Lowest replaceable unit” (LRU) of malfunctioning network component will be replaced (could be single board, might be entire component)
  - Failure diagnostic testing of malfunctioning part is non-realtime function
- Component repair
  - All Cisco hardware covered under Cisco SmartNet service agreement (Provides technical support and spare parts delivery overnight)

Sustaining Engineering

- Functions to be performed
  - Migration to EBNet Release B support
  - Software/hardware upgrades
  - Administration of network hardware
  - Reconfiguration of network hardware/software
  - Escalated problems

IV. B. Operations Concepts for AM-1

Karen Petraska-Veum

High Level Operations Concepts AM-1

- Staffing
- Roles and Responsibilities
- Escalation Process
- Operations Policy
- Maintenance Policy
- Sustaining Engineering

Staffing

- Comm Manager (24x7 on site)
- In the Network Operations Center (NOC)
  - 2 Operators staff Helpdesk (24x7 on site)
    - Lead
    - Backup
  - Network manager (8x5 on site, 24 hour on-call)
- At GSFC
  - Maintenance technicians (24x7 on site)
- At other sites:
  - Potential agreement with DAAC staff (8x5 on site, 24 hour on-call)
  - Vendor support (4 hour service restoral)
- In the Sustaining Engineering Facility (SEF)
  - Design engineers (8x5 on site)

Roles and Responsibilities

- Comm Manager
  - Coordination of information and events across all Nascom elements including EBnet
- Lead and back-up operators
  - Working knowledge of all applications and operating systems
  - Interface with customers and users via the helpdesk to isolate, diagnose and resolve problems
- Network manager
  - All functions performed by operators
  - Second tier troubleshooting and problem resolution
  - Understand system-wide issues
  - Resolve all open problems

Escalation Process

- First tier: Operators
- Second tier: Network manager
- Third tier: Design engineers
- Fourth tier: Vendor maintenance and technical troubleshooting agreements

Operations Policy

- Enterprise Management Concept (EMC) Team will define a more cohesive, state-of-the-art enterprise-wide framework for exchange of operational and management data. (EBnet is a small piece of a much larger puzzle)
- Network operations and management data will be exchanged electronically between EBnet and SMC
- Operators in this scenario will have a much higher skill level than operators on legacy systems
- The Comm Manager is the focal point for information exchange and coordination across all Nascom systems. The Comm Manager coordinates with the EBNet NOC Helpdesk

EBnet

EBnet TRMM Review

From User Organizations, HPOV/Operator observation, Comm Manager

Problem Alert!!!

Open Trouble Ticket!

Operator troubleshoots to isolate/resolve problem

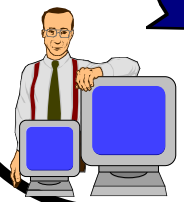
Involves engineers, carriers, remote site personnel and vendors as necessary

EBnet NOC Operator

Operator closes trouble ticket when problem is resolved

Keep Comm Manager Informed!

Comm Manager keeps users informed!



Maintenance Policy

- Spares
  - Partial vs. full
- “Lowest replaceable unit” (LRU) of malfunctioning equipment will be replaced instead of entire system (sometimes LRU will be a board, sometimes an entire box)
  - Failure diagnostic testing is non-realtime
- Component repair will be done via vendor maintenance agreements

Sustaining Engineering

- Functions to be performed
  - Delivery II network management design
  - Software/hardware/firmware upgrades
  - Sophisticated system administration functions
  - Reconfiguration of hardware/software
  - Trend analysis
  - Escalated problems

V. Risks

Chris Garman

Risks

- Traffic Requirements Traceability
- Requirements Volatility
- 2X Mean Time To Restore Service (MTTRS) Maximum Downtime
- Site Surveys

Traffic Requirements Traceability

- TRMM Traffic requirements have been identified and solid topology in-place to support testing. Traffic requirements for AM-1 and beyond still being defined
- Traffic located in numerous places (e.g., Table 4, Ad Hoc Working Group on Production [AHWGP], Interface Requirements Document [IRDs])
  - Technical risk: low due to inherent modularity of Commercial Off-The-Shelf (COTS) router technology
  - Schedule risk: moderate due to inherent need for continual design studies and common carrier and equipment procurement lead time
  - Cost risk: moderate due to potential need for circuits and router equipment
- Mitigation Plan: Place traffic in controlled EBnet Traffic Database. Continual involvement in user and engineering meetings to receive latest requirements information

Requirements Volatility

- Traffic requirements continue to change
- RESHAPE (Adaptive Downlink) studies ongoing
- MSFC Distributed Active Archive Center (DAAC) termination Configuration Change Request (CCR)
  - Technical risk: low due to inherent modularity of COTS router technology
  - Schedule risk: moderate due to inherent need for continual design studies and common carrier and equipment procurement lead time
  - Cost risk: moderate due to potential need for circuits and router equipment
- Mitigation Plan: Place traffic in controlled EBnet Traffic Database. Continual involvement in user and engineering meetings to receive latest requirements information

2X MTTRS Maximum Downtime

- Requirements working group analyzing Level 2 requirement for “2X MTTRS maximum down time” which would drive EBnet design to redundant network
  - Technical risk: moderate due to need for redundancy
  - Schedule risk: moderate due to need for network redesign
  - Cost risk: moderate due to need for redundant circuits
- Mitigation Plan: Generate network topology which supports redundancy and associated cost profile to support Level 2 requirement analysis

Site Surveys

- There are currently no travel funds to perform initial site surveys
  - Technical risk: low due to existing presence at all TRMM nodes
  - Schedule risk: low for TRMM; we are ready to support Interim Release One (IR1)
  - Cost risk: low due to the fact that adequate funds exist if budget is approved at current ceiling
- Mitigation Plan: Establish contact with appropriate site personnel and work facility and design activities over the telephone to the maximum extent possible; use existing Version 0 network

IST Requirements

- NASA Science Internet (NSI) still analyzing support requirements. Could result in requirements being shifted to EBnet
  - Technical risk: low due to inherent modularity of COTS router technology
  - Schedule risk: moderate due to traffic/interface requirement analysis
  - Cost risk: low due to existing ESDIS budget for NSI traffic
- Mitigation Plan: Begin analyzing traffic requirements in anticipation of Instrument Support Terminal (IST) support responsibility

VI. Conclusion

Steve Smith

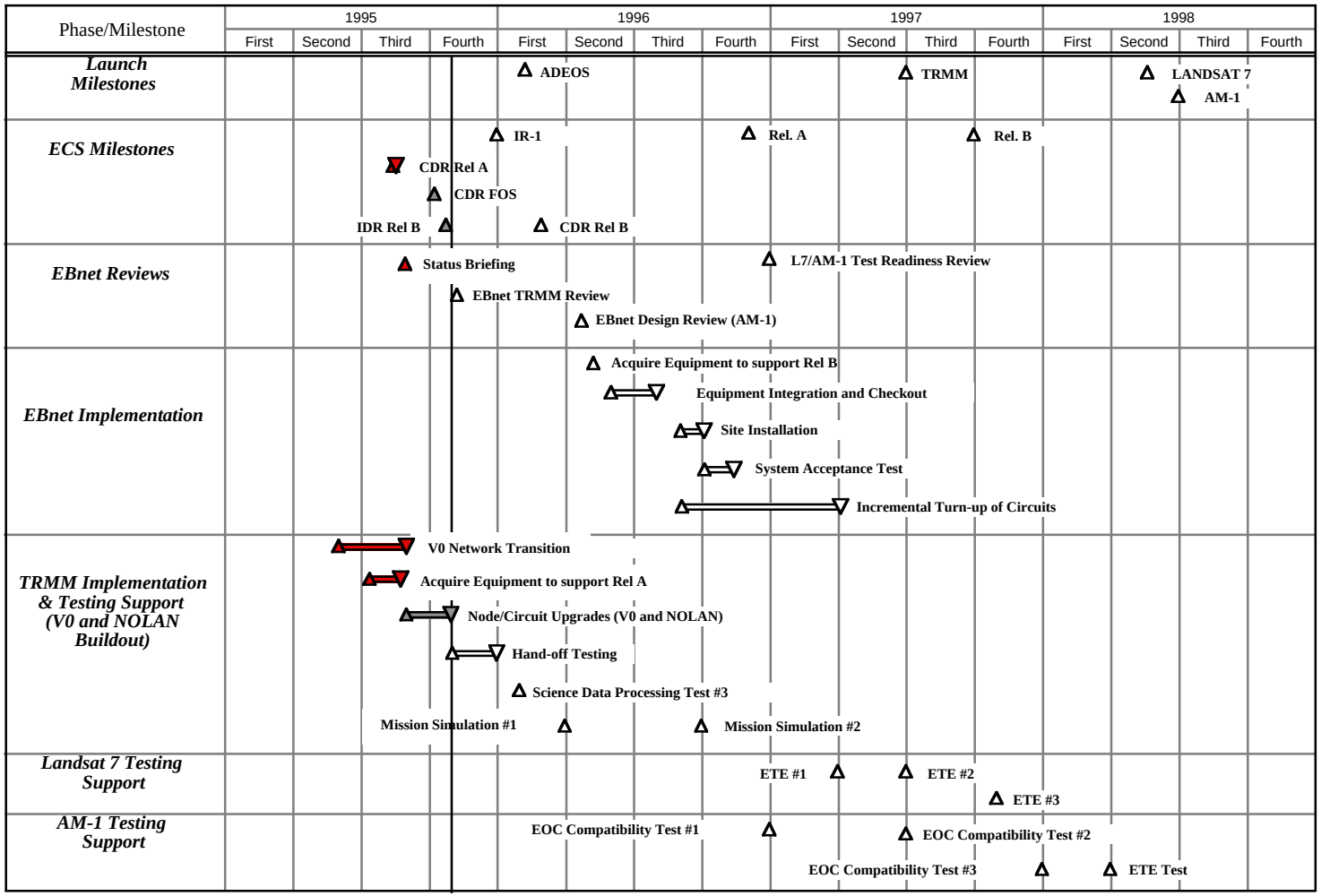
Schedule Considerations

- EBnet project Project Evaluation Review Technique (PERT) chart identifies customer-driven milestones; primary schedule drivers include TRMM IR-1 test support required by January 1996, test support for Release A required by July 1996, and AM-1 test support required by January 1997
- EBnet critical path is dependent on external milestone (i.e., ECS Release B CDR)
  - 17 days slack between EBnet AM-1 Review and AM-1 Test Readiness Review (TRR)
  - 19 days slack between ordering equipment and AM-1 Test Readiness Review (TRR)
- Master Schedule shows high level milestones, dependencies, and activities for specific segments during the Project life-cycle
- Detailed Milestone schedule identifies specific activities necessary to reach EBnet AM-1 Review, circa April 1996

EBnet

EBnet TRMM Review

Master Schedule



Success Criteria Summary

- Functional and performance requirements are documented in the ESDIS Requirements, Volume 6, for the EBnet Project; traffic requirements are maintained in the EBnet Traffic Database
- Documentation suite has been defined for the full life-cycle
- External and internal interfaces for TRMM have been documented, and preliminarily identified those for AM-1
- TRMM operations concept has been defined (de facto NASCOP, Volumes 1 and 2, Revision 2, January 1992)
- The EBnet Project is prepared to support TRMM IR-1 testing, and is on schedule to support AM-1, Landsat, and other missions to follow
- TRMM network transport and management capabilities, design, and circuit topology are completed; preliminary AM-1 design and circuit topology are identified
- All significant implementation events, critical path, and external dependencies have been considered, and risk mitigation plans are in place as appropriate

RID Process Recap

- Use the RID form as supplied in hard-copy or on the EBnet Home Page at:

  http://skynet.gsfc.nasa.gov/EBNET/EBnet.html
- Transmit RIDs via e-mail to:
- BERGANSKIK@BAH.COM no later than 11/20/95

Please use the “COMMENT/CLARIFICATION FORMS,” located in the back of the auditorium, if you would like to submit a comment or have one of our presenters contact you to elaborate on a point made during the presentation.

ACRONYMS

ACRONYMS

ACS	Attitude Control System
AHWGP	Ad Hoc Working Group on Production
ARS	Action Request System
ASF	Alaska SAR Facility
ASTER	Advanced Spaceborne Thermal Emission Radiometer
ATSC	AlliedSignal Technical Services Corporation
BA&H	Booz•Allen & Hamilton Incorporated
BGP	Border Gateway Protocol
c/d	clock/data
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CERN	Conseil Europeen pour la Recherche Nucleaire
CNE	Center Network Environment
COTS	Commercial off-the-shelf
CSC	Computer Sciences Corporation
DAAC	Distributed Active Archive Center
DID	Data Item Description
DIF	Data Interface Facility
DMR	Detailed Mission Requirements
DSN	Deep Space Network
DSNO	Distributed Systems Networks Organization
EBnet	EOSDIS Backbone Network
Ecom	EOS Communications
ECS	ESDIS Core System
EDC	EROS Data Center
EDOS	EOS Data and Operations System
EMAT	EBnet Modeling and Analysis Testbed
EMC	Enterprise Management Concept
EOC	EOS Operations Center
EOP	EDOS Operational Prototype
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
ESN	EOS Science Network
ETE	End-to-End
ETS	EOS Test System
FDDI	Fiber Distributed Data Interface
FDF	Flight Dynamics Facility
FOS	Flight Operations Segment
FSTB	Flight Software Testbed

ACRONYMS

FTS	Federal Telecommunications System
GDS	Ground Data System
GHCC	Global Hydrology Change Center
GN	Ground Network
GSE	Ground System Equipment
GSFC	Goddard Space Flight Center
HDS/ETU	Hybrid Dynamic Simulator/Engineering Test Unit
HP	Hewlett Packard
HP OV	Hewlett Packard OpenView
ICD	Interface Control Document
IP	Internet Protocol
IR	Interim Release
IRD	Interface Requirements Document
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IST	Instrument Support Terminal
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
kbps	kilobits per second
LAN	Local Area Network
LaRC	Langley Research Center
LPS	Landsat Processing System
LPS	Landsat Processing System
LRS	Low Rate System
LRU	Lowest Replaceable Unit
LSM	Local System Management
Mbps	megabits per second
MDM	Multiplex-Demultiplex
MOC	Mission Operations Center
MODNET	Mission Operations Directorate Network
MPS	Multimode Portable Simulator
MRTT	Mission Readiness Test Team
MSFC	Marshall Space Flight Center
MSFC	Marshall Space Flight Center
MSS	Message Switching System
MTPE	Mission To Planet Earth
MTTRS	Mean Time To Restore Service

ACRONYMS

MUX	Multiplexer
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NASCOP	Nascom Operations Procedures
NASDA	National Space Development Agency (of Japan)
NCC	Network Control Center
NESDIS	National Environmental Satellite, Data and Information Service
NJ	New Jersey
NMCC	Network Management Control Center
NMS	Network Management System
NNM	Network Node Manager
NOAA	National Oceanic and Atmospheric Administration
NOC	Network Operations Center
NOCC	Nascom Operations Control Center
NOLAN	Nascom Operations Local Area Network
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
OSPF	Open Shortest Path First
PERT	Project Evaluation Review Technique
PSCN	Program Support Communications Network
RID	Review Item Disposition
RIP	Routing Information Protocol
RMA	Reliability, Maintainability, Availability
RMON	Remote Monitoring
RT	Real Time
SAR	Synthetic Aperture Radar
SAS	Statistical Analysis System
SCS	Spacecraft Checkout Station
SDF	Software Development Facility
SDPF	Science Data Processing Facility
SEF	Sustaining Engineering Facility
SI&T	System Integration and Test
SMC	System Monitoring and Coordination Center
SNMP	Simple Network Management Protocol
SOC	Simulations Operation Center (Bldg. 25)
SQL	Simple Query language
SSIM	Spacecraft Simulator

ACRONYMS

STGT	Second TDRSS Ground Terminal
TBD	To Be Determined
TBR	To Be Reviewed
TDRSS	Tracking Data Relay Satellite System
TKSC	Tsukuba, Japan
TRMM	Tropical Rainfall Measurement Mission
TRR	Test Readiness Review
TSDIS	TRMM Science Data and Information System
V0	EOSDIS Version 0
VDS	Voice Distribution System
VSS	Voice Switching System
WFF	Wallops Flight Facility
WOTS	Wallops Orbital Tracking Station
WSC	White Sands Complex
WWW	World Wide Web
YLC	Yoshinobu Launch Complex (Japan)